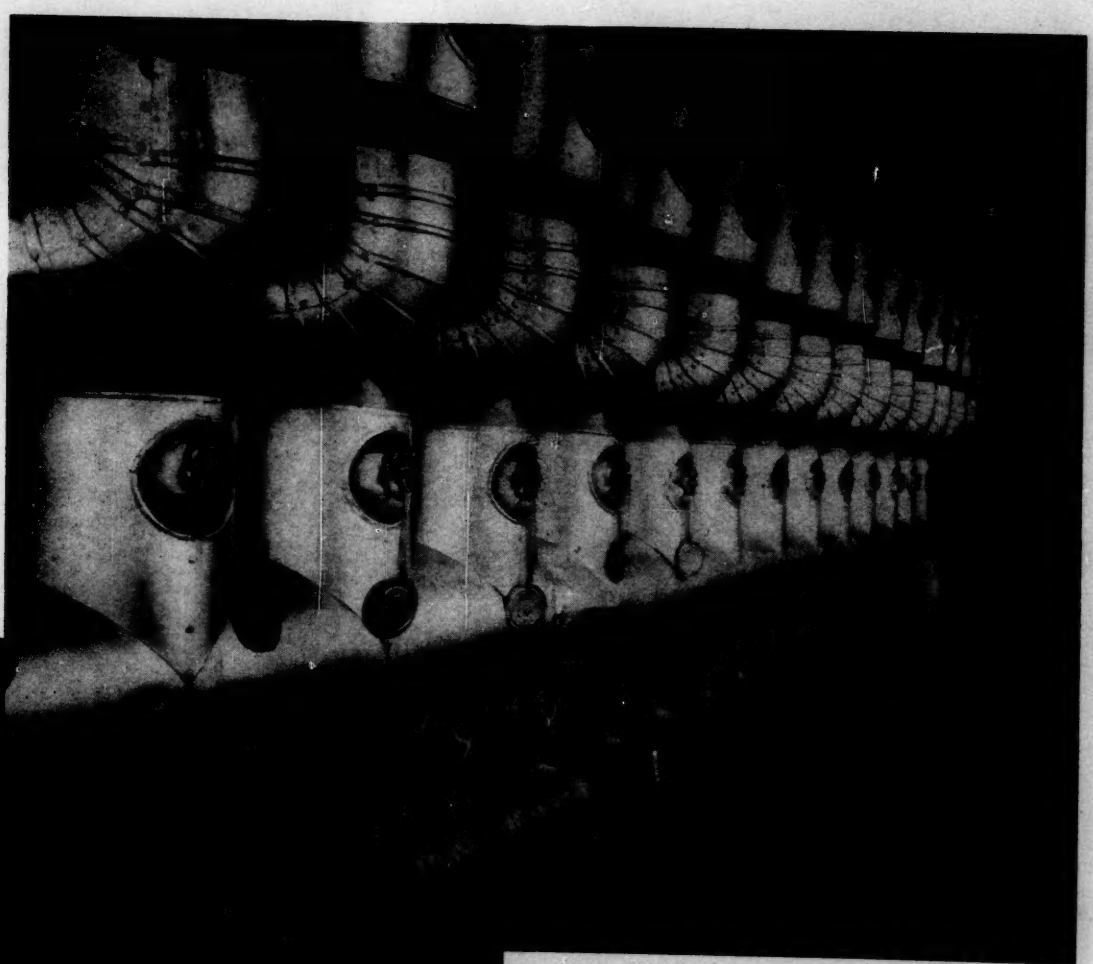
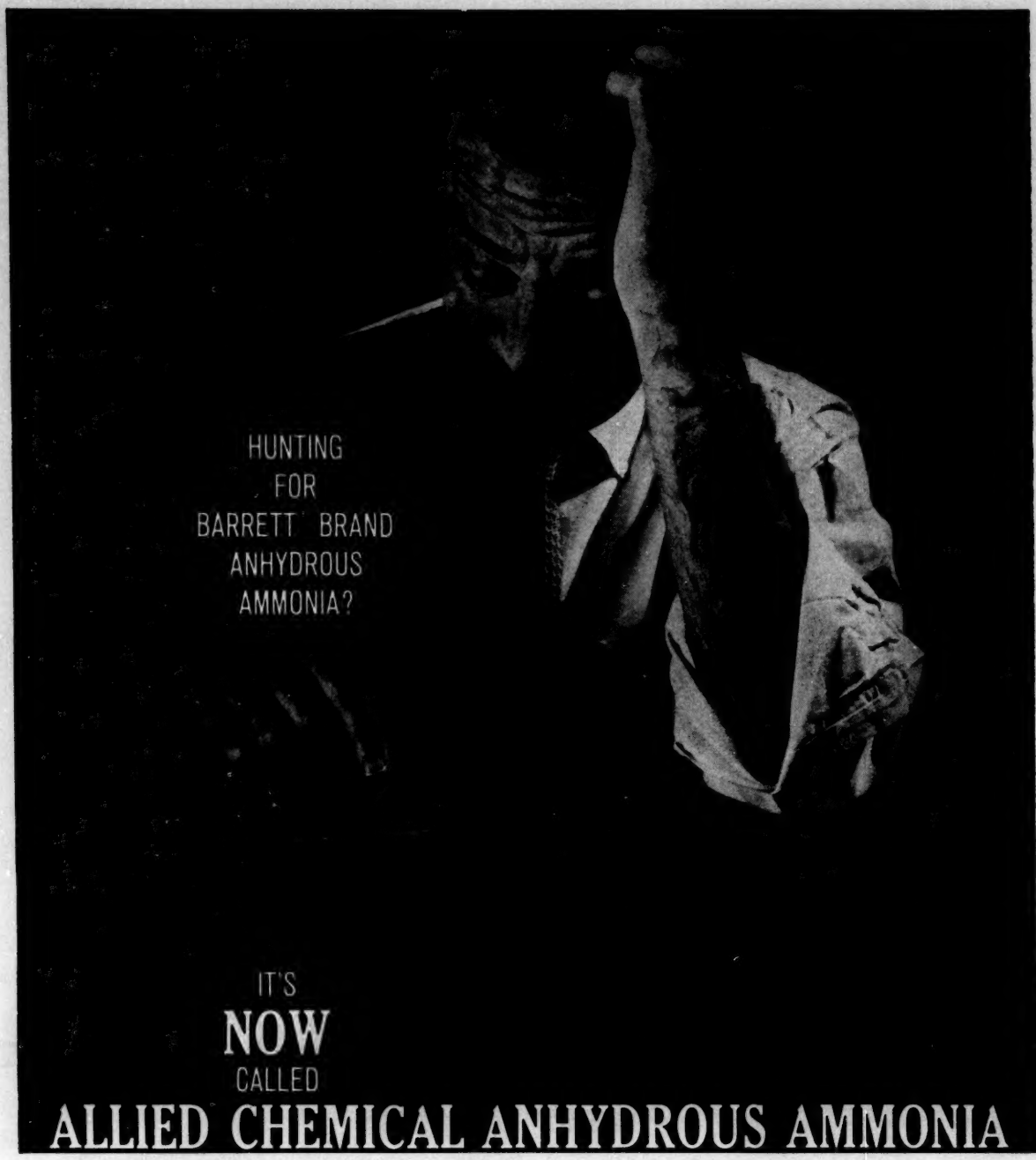
For the men who SPECIFY, BUY and OPERATE
Refrigeration and Air Cooling Equipment

Industrial Refrigeration

NOVEMBER
1960



COVER—Header room for a fourteen room quick freezing plant in New Zealand. Story on page 10.



The name "Barrett Brand" – known throughout the refrigeration industry – has been changed to ALLIED CHEMICAL ANHYDROUS AMMONIA. Otherwise, there's been no change. Same quality product, same green identifying cap on the cylinder.

Whether you use an absorption or compression system, ALLIED CHEMICAL AMMONIA is still the most economical and efficient refrigerant you can buy.

ALLIED CHEMICAL ANHYDROUS AMMONIA is supplied in 150, 100, and 50-pound cylinders with the identifying green cap. For prompt service on your orders, check the yellow pages of your phone book under "Ammonia" for your nearest ALLIED CHEMICAL ANHYDROUS AMMONIA distributor.

BASIC TO AMERICA'S PROGRESS

Allied Chemical

NITROGEN DIVISION
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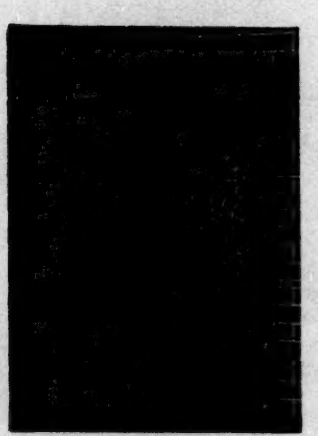
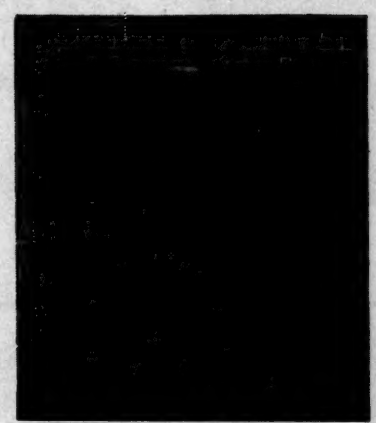
THE INDUSTRY'S FINEST...

ALL TYPES



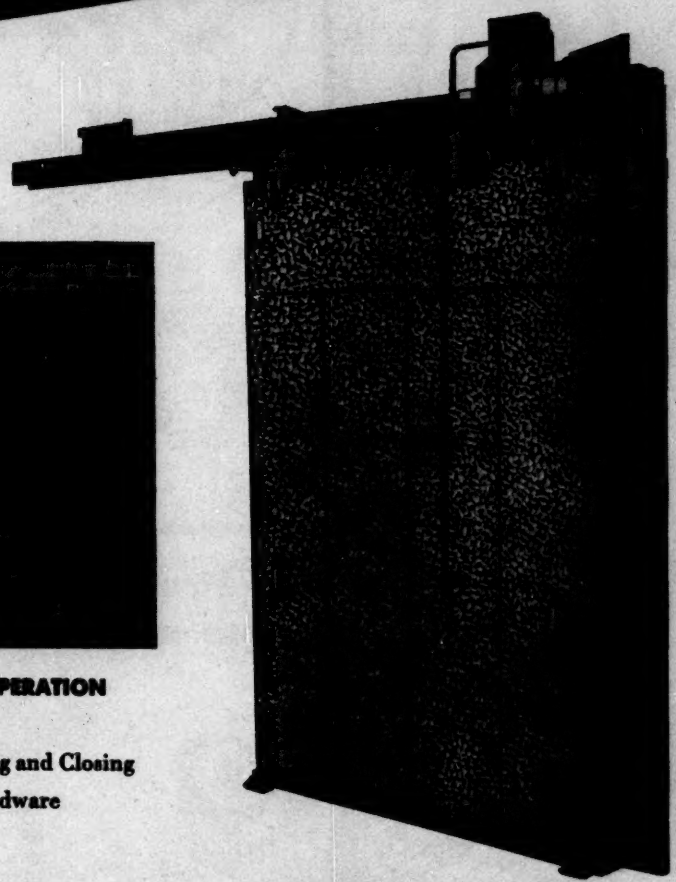
AIR OPERATION

- Safety Entrance and Exit Through Built-In Refrigerator Door
- Speedy Opening and Closing



MANUAL OPERATION

- Dependable
- Easy Opening and Closing
- Durable Hardware



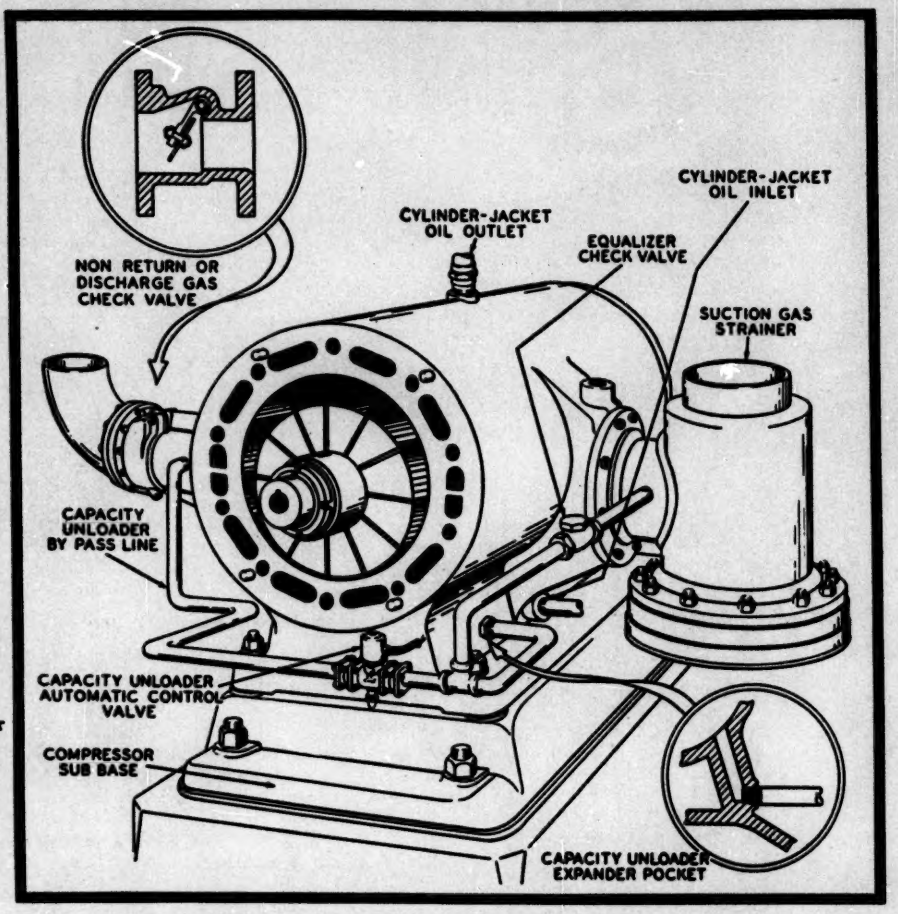
"Electro" SAFETY SLIDE

- Structural Simplicity
- Mechanically Sound
- Exclusive Automatic Sealing
- Gear Type Uni-Brake Motor Operation (no belts)

BI-PARTING "ELECTRO" SAFETY SLIDE DOORS

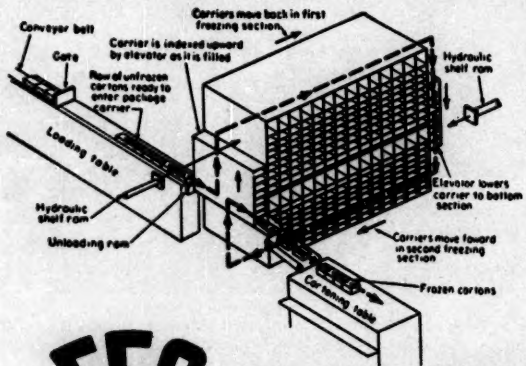
- Recommended where space factors dictate their use
- Gear Type Uni-Brake Motor Operation (no belts)

Write for descriptive bulletin . . .


CYLINDER-JACKET OIL INLET
CYLINDER-JACKET OIL OUTLET
EQUALIZER CHECK VALVE
NON RETURN OR DISCHARGE GAS CHECK VALVE
SUCTION GAS STRAINER
CAPACITY UNLOADER BY PASS LINE
CAPACITY UNLOADER AUTOMATIC CONTROL VALVE
COMPRESSOR SUB BASE
CAPACITY UNLOADER EXPANDER POCKET

FES-Fuller Rotary Compressor

These Product Features Make FES-Fuller Boosters and Freezers Your Best Buy


Conveyor belt
Cans
Carriers move back in first freezing section
Carrier is indexed upward by elevator as it is filled
Row of unfrozen cartons ready to enter package carrier
Loading table
Hydraulic shelf ram
Unloading ram
Hydraulic shelf ram
Elevator lowers carrier to bottom section
Carriers move forward in second freezing section
Frozen cartons
Carrier
Carrier table

Isometric diagram of FES Package Freezer. Packages are quickly and efficiently moved from front to rear of honeycomb cell where they drop to lower section of freezer.

When you specify FES-Fuller, you get products which are *engineered* to give you long service, minimum maintenance and low cost operation. Want proof? Check these special product features . . .

FES-Fuller Rotary Booster gives you automatic capacity unloading, built-in positive non-return or discharge gas check valve, simplicity of design for less wear, dependability. And you get all these advantages at competitive first cost.

FES Automatic Ice Cream Hardener offers fast, efficient freezing, accommodates a wide assortment of package sizes and shapes, speeds handling, cuts space requirements, prevents product damage, lowers labor costs.

There are many other features that add up to operating efficiency. If you are planning to increase capacity, lower temperature or build a new plant, it will pay you to write for complete information on FES-Fuller Rotaries.

1317-B
C341A

FES FULLER

FREEZING EQUIPMENT SALES, INC., 1405 N. DUKE Street, YORK, PA.

Qualified distributors in principal cities

LOW TEMPERATURE FREEZING EQUIPMENT

Industrial Refrigeration

November 1960

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A NATIONAL MAGAZINE FOR:

- **Plant Engineers and Operating Personnel**
- **Application Engineers and Contractors**

WHERE REFRIGERATION EQUIPMENT IS USED FOR:

- **Food Freezing, Storage and Transport**
- **Processing and Cooling Applications**
- **Research and Development**

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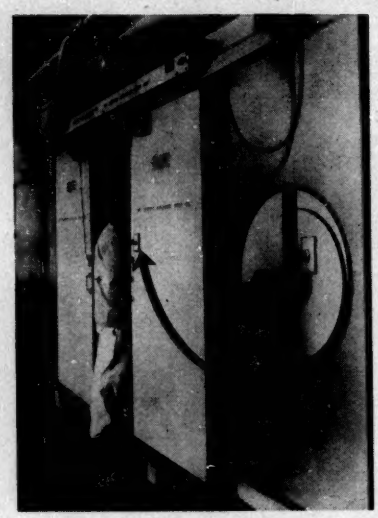
69 Years of Continuous Publication

New Products Designed to Improve Operation

Pedestrian Switch For Cold Storage Doors

AVAILABLE for incorporation in new or existing Prest-O-Matic cold storage doors is a new pedestrian switch, known as the Partial Opening Man (POM) Switch. Designed by Clark Door Company, Inc., it opens doors only 32" wide to accommodate foot traffic, thereby saving time and refrigeration. The door closes automatically behind the pedestrian.

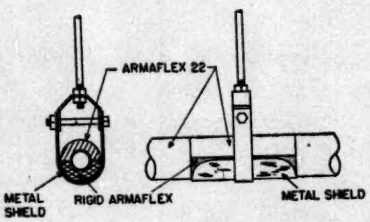


In surveying numerous doorways leading to blast freezers, cold storage and other refrigerated areas, the Clark Company found that up to 50% of doorway traffic was pedestrian. Since the typical automatic door is controlled by pull cord switches which open the door to its full width, the POM Switch was engineered to eliminate unnecessary losses of cold air and man hours.

Clark Doors can now be equipped with two door-mounted push-buttons, one on either side of the door panel. A pedestrian presses the POM Switch at either side. The door opens 32 inches, permitting the individual to walk through, then closes automatically. Already applied to many doors leading to frozen food distribution warehouses, ice cream hardening rooms and frozen bakery products storage areas, the POM Switch is suitable for any Prest-O-Matic doorway used by foot traffic as well as fork trucks. Further information may be obtained from Clark Door Company, Inc., 182 Rose Street, Newark 8, New Jersey.

Pipe Hanger Insulation

A RIGID foamed plastic material to be used as a load bearing insulation at pipe hanger locations, deeply buried underground lines and other areas where pipe covering may be subject to compression set deformation has been developed by the Armstrong Cork Company Insulation Division.



The new material, called Rigid Armaflex, has physical properties similar to Armstrong Armaflex 22, a flexible foamed plastic pipe covering. Rigid Armaflex was developed to be used in conjunction with the flexible material.

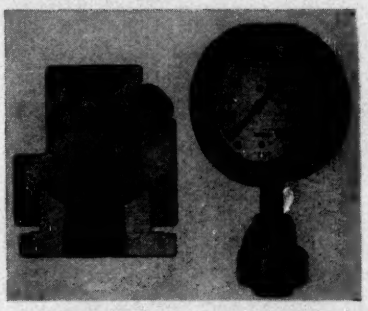
Rigid Armaflex is available in nominal ½" and ¾" thicknesses for sizes ⅜" i.d. to 3" i.p.s. and is furnished in pre-matched half sections three feet long.

Armaflex is widely used on liquid cooling and heating lines, chilled water lines, and other cold lines in plumbing, heating, air-conditioning, refrigeration and industrial processing applications.

Accessories For Protection Of Pressure Gauges

TWO newly-designed pressure gauge accessories, a "pulsation dampener" and a "chemical attachment", are announced by United States Gauge Division of American Machine & Metals, Inc. The two units, which are similar in basic design, offer improved performance and easier maintenance where gauges must be protected from the damaging effects of pulsating pressures or corrosive chemicals.

Both accessories have a diaphragm (stainless steel or Neoprene) which separates the measured fluid from the gauge measuring element. Space above the diaphragm is filled with a viscous, non-freezing liquid which transmits the measured pressure to the gauge element. For pulsation dampening, there is an adjustable restriction in a passage from the diaphragm top to the gauge. The design permits access to this passage at the side of the unit; it is not necessary to unscrew the gauge to fill the top chamber or perform routine maintenance.



Wherever practical, the pulsation dampener or chemical attachment should be purchased as an integral unit with the gauge, because the supplier has the proper techniques for assembling the two, adding the filling oil, and adjusting the gauge for maximum service life. Either attachment can, however, be bought separately and comes with complete instructions for installation and maintenance.

The pulsation dampener has a threaded plug, externally adjustable with a socket head wrench. A tapered slot in the side of this plug varies the opening of the passage to the gauge. This regulates the degree of damping for all conditions of flow, viscosity, and rate of pressure pulsation. Gauges equipped with the dampener can be used with fluid temperatures between (50 and 100°F.) without temperature correction. When used at temperatures outside of these limits, the gauge will be accurate only at the temperature at which it is calibrated.

The new chemical attachment is designed to prevent measured fluids from clogging or corroding the gauge spring element. In addition, it can also be used for pulsation dampening, having the same basic design of adjustable passage. The attachment is normally intended for direct mounting to the gauge socket. It can, however, be mounted some distance from the gauge; in such cases, a capillary is used to connect the attachment to the gauge.

Time Switch "Rests" Equipment

A NEW 14-day time switch, announced by Tork Time Controls, Inc., "works" but once a week. It is used to turn a motor "on" one week and "off" the next, and is designed specifically to allow pumps, motors, or other equipment to "rest".

Many installations use two sets of pumps or motors, to be worked on an alternating schedule. Standard time controls could provide only a daily or every-two-day alternating schedule. Such short alternation does not provide equipment with sufficient "rest", and shortens the life of pumps, motors, etc.

The new switch, is a single-pole double-throw time switch. Its dial makes a complete revolution in 14 days . . . as compared with 24 hours for a standard time switch. Every 7 days, the unit "make-breaks" to put one set of equipment on and the other off. This provides the full week rest recommended by manufacturers.

The Great Atlantic & Pacific Tea Co. • Jos. Schlitz Brewing Co. • St. Luke's Hospital • Tropicana, Inc. • Armour & Co. • Neil House • The Fish Meal Co. Standard Brands, Incorporated • Coca-Cola Co. • The Borden Co. • Swift & Co. Sperry Candy Co. • Union League Club • Miller Brewing Co. • Carnation Company • The Kroger Co. • Minute Maid Corp. • The Seven-Up Bottling Co. Wilson & Co., Inc. • Saltest Foods • Anheuser-Busch, Inc. • Foremost Dairies, Inc. Rath Packing Co. • Pepsi-Cola Co. • Marine Bank • Falstaff Brewing Corp. Pet Milk Co. • Norbest Turkey Growers Assn., Inc. • Merchants Refrigerating Co.

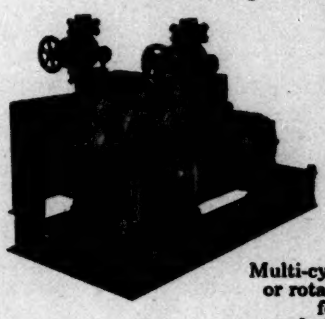
"IT [illegible] TO BE YOU" . . . VILTER

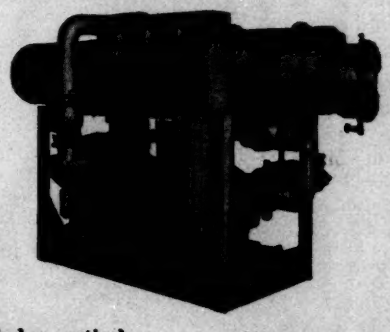
often said and a well founded choice among many leading American companies when it comes to selecting quality refrigeration and air conditioning equipment. (A few of the thousands of valued Vilter customers are shown above.) They all consistently look to Vilter for sound refrigeration and air conditioning recommendations and for reliable, efficient-performing, economical-to-operate equipment.

Vilter equipment finds wide application in all industries where refrigeration and air conditioning are used—from industrial installations in meat packing and poultry plants, dairies, breweries, refrigerated fishing vessels, frozen food plants—to air conditioning systems in important hotels, motels, office buildings and hospitals.

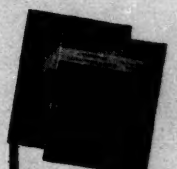
With a complete line of industrial and commercial refrigeration and air conditioning equipment, Vilter can provide a system to exactly fit your needs.

Packaged water chillers for air conditioning.





Multi-cylinder, vertical or rotary compressors for refrigeration and air conditioning.



Vilter refrigeration air conditioning

The Vilter Manufacturing Company
Milwaukee 7, Wisconsin

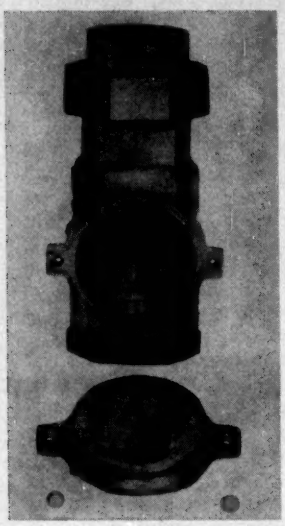
Air Units • Ammonia and Freon Compressors • Booster Compressors Baudelot Coolers • Water and Brine Coolers • Blast Freezers Evaporative and Shell and Tube Condensers • Pipe Coils Valves and Fittings • Pakice and Polarflake Ice machines.

Write for your copies of bulletins covering the above equipment to The Vilter Manufacturing Company, Dept. H-606 2217 South First Street Milwaukee 7, Wisconsin

New Products cont.

Vertical Check Valve Holds Prime

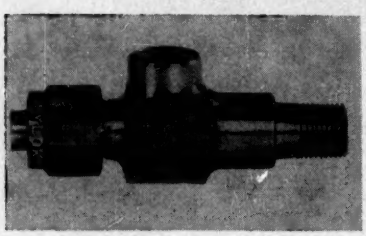
VERTICAL check valves now available from OPW-Jordan, are used wherever it is necessary to maintain a prime in liquid lines. In



operation, the disc swings completely out of the flow passage, for minimum pressure drop. When flow stops, the disc swings downward to a raised seat. A compensator ring provides even pressure on all sides of the disc against the seat, eliminating uneven seating or loss of prime. A bronze cap on the disc of the valve permits easy servicing.

4-Seal T-Fitting

A TYLOK 4-Seal T-Fitting now eliminates the need for adapters, connectors and special fittings

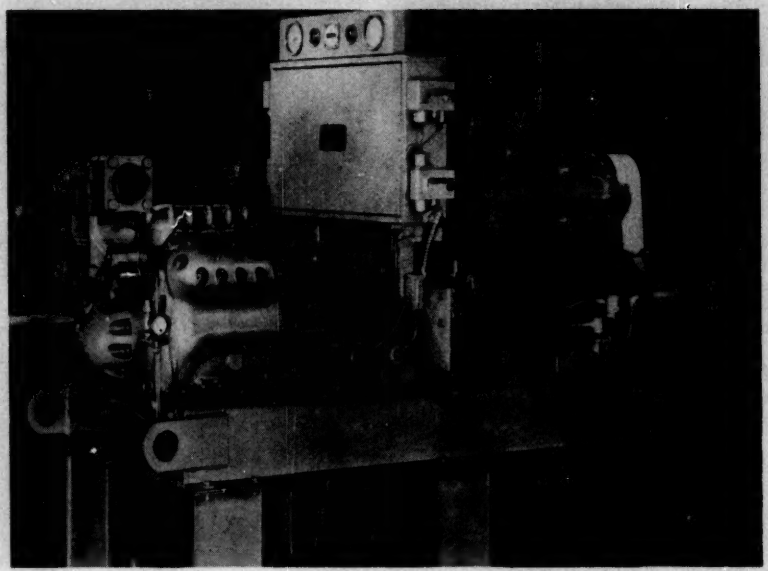


when applying pressure gauges or other instruments to hydraulic, pneumatic and process lines.

This new all-purpose fitting gives the benefits of a single-piece installation, rather than the disadvantages of a complex, multiple group of components including tubing, fittings and adapters. Economy, ease and speed of installation, and a greater measure of sealing safety are assured. The unit is available in aluminum, brass, monel, steel and stainless steel.

T-Fittings embodies four positive seals against pressure, temperature, vibration, surge, plus vibration dampener. It is offered in size range from 1/16" through 2" diameters, with pipe thread.

Gas Motor-Powered Refrigeration Units



REFRIGERATING units powered by natural gas-fueled engines are the newest development out of Bell & Gossett Co.

The company is now making three basic cooling units for industrial and commercial use: a package liquid cooler unit for water cooling systems, a refrigeration condensing unit series, and an engine compressor unit.

The liquid cooler unit is a complete cooling package, containing compressor, condenser, heat exchanger, centrifugal pumps and evaporator. It's completely enclosed in a rugged but neat steel frame and the whole unit is automatic.

The refrigeration condensing unit series, compact and rugged in construction, includes 12 units ranging in capacity from 7½ tons to 150 tons. Bolts are used in the construction of these units rather than welding to simplify maintenance.

The new engine compressor unit has an infinite modulation range, from 1800 rpm. to 1200 rpm. Its lubrication supply oils the unit for 2000 hours—a full season's operation without refilling.

Flexible Connectors For Pumps

TROUBLESOME effects of pipeline vibration, misalignment, or thermal expansion in pump installations are absorbed or reduced by flexible pump connectors, intro-

duced by Allied Metal Hose Company.

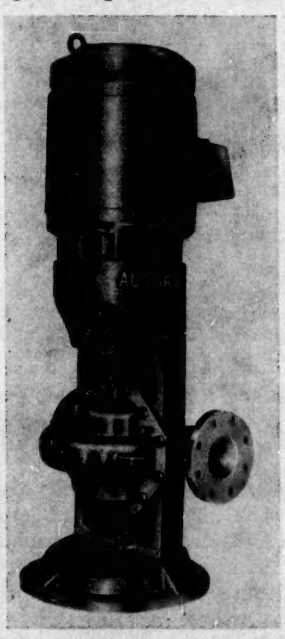
Consisting of a short section of corrugated flexible metal tubing, protected against pressure elongation by wire braid, these pump connectors are furnished with threaded or flanged end connections to fit all standard piping sizes; and

are available from ¼ through 16 in. in stainless steel, ¼ through 8 in. in bronze and hot-dip-galvanized steel, and ¼ through 4 in. in monel.

Material, lengths, and construction are varied to suit the conveyed fluid, pressures, temperatures, and movements encountered. Pump Connectors handle pressures to 1500 psig, depending on alloy, braid construction and size. Their helical, rather than annular, corrugations offer less resistance to flow, while distributing stresses along entire hose length to minimize localized failures.

Vertical Single-Stage Centrifugal Pumps

REDUCED space requirements for a new line of vertical split case pumps makes them ideal for applications where extreme compactness is of prime importance. The case is



split parallel with the impeller shaft with the suction and discharge flanges integral in the vertical base section. Rotating unit is removed easily for inspection or maintenance without distributing the suction or discharge piping connections. Bearing alignment is achieved with in-line boring with top half of case in position. Double suction impellers are hydraulically and dynamically balanced for smooth quiet operations. Ideal for handling high capacities at medium to high heads and continuous operations these pumps are used on applications such as marine services, industrial water service, booster service, cooling towers, circulating and boiler feed. Capacities range to 6000 gpm and heads to 380 feet. Makers are Aurora Pump Division, The New York Air Brake Company.

Insulation Sealer

A NEW insulation sealer that provides maximum protection for all commonly used types of insulating materials and yet reduces protection costs has been introduced by the Glidden Company.

The product, called Insulcap, is specifically formulated as a barrier against loss and inconvenience caused by condensation on insulated equipment exposed to moisture and temperature variations. Typical applications areas include covered duct work, steam pipes, hot water lines, furnaces, breechings, converters and digesters.

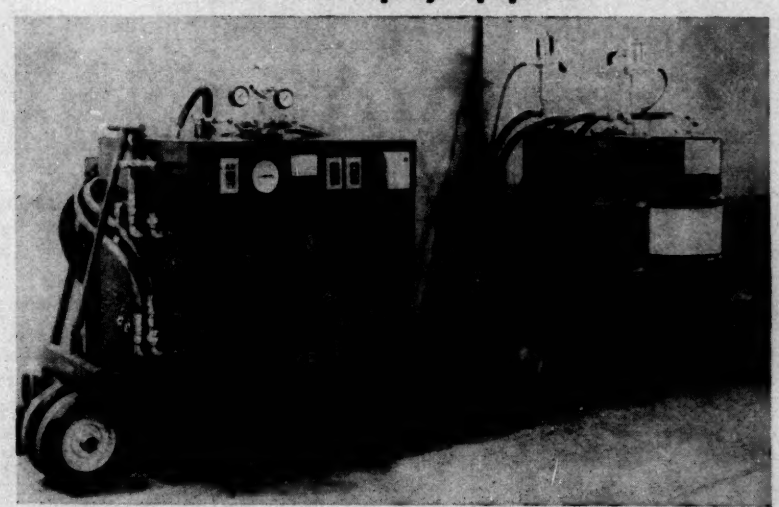
Costs are cut by priming and finishing with one material. Glue sizing is eliminated.

The product has shown excellent results, according to Glidden, when used on insulation and pipe coverings that cannot be completely dried before painting. Its resistance to water, moisture vapor, acids, alkalies and general corrosive conditions give it good aging characteristics on insulating materials including fabrics, asbestos products, glass fibers, cork board, foam glass, papers and felt.

The rapid release of moisture from the sealer film produces a superior adhesion without penetration. It dries to the touch within 20 minutes at 70 degrees Fahrenheit and may be recoated in four hours. Tests have indicated that the film increases the structural strength of insulating material as well as keeping it neat in appearance. It is highly resistant to mold and mildew.

It is almost completely odorless when wet, enabling application without discomfort in close quarters. It is completely odorless when dry. The product is ready to use without thinning and is easily applied with wide brush, spray gun, roller or mitten.

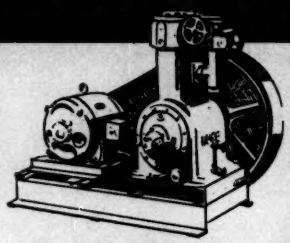
Plastic Foam Spray Equipment



PICTURED is a rig manufactured by Raven Industries, Inc., of Sioux Falls, So. Dak., out of the spray guns of which comes a lightweight urethane foam. Top usage for the foam is insulation for steel buildings, tanks and silos, old or new wooden construction, refrigerated rooms, trucks, etc. With the Raven rig, two liquid components are pumped from separate containers, pictured right. The liquids are accurately measured, conditioned and sprayed into a spray gun where they are mixed, atomized and ejected.

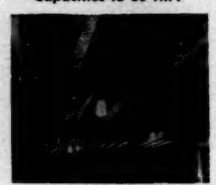
When the sprayed solution hits a surface . . . wood, aluminum, steel or concrete . . . it forms an economical, lightweight, rigid foam.

STAY AHEAD
OF COMPETITION
HERE'S HOWE!



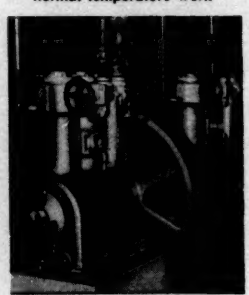
COMPRESSOR ASSEMBLIES
Capacities to 60 H.P.

HOWE REFRIGERATION works in so many fields—where compressors and components have vastly different jobs to do—that experience gained in one field often helps solve problems in other fields.



POLAR CIRCLE COILS
For freezer storage as well as normal temperature work

HOWE'S broad and long (48 years) experience is one way our engineers can help you stay ahead of competition. Let us demonstrate the value of this specialization by bringing you more efficient operation and better profits. *It pays to know HOWE!*



HOWE COMPRESSORS
For every size load and application. 5 to 150 tons

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HOWE 3-Fan UNIT COOLERS
For heavy duty, high tonnage blast freezing, freezer storage.

HOWE ICE MACHINE CO.

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Distributors in Principal Cities

Cable: HIMCO Chicago

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GENUINE
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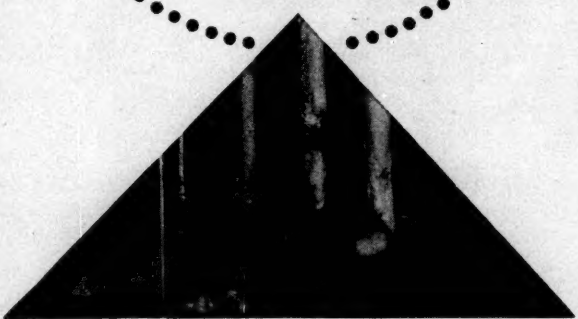

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news briefs of the month

Poultry Industries Report On Turkey Storage

Inventory figures on classes of turkeys in storage on September 30 have been released by the Institute of American Poultry Industries. A total of 102,950,820 pounds of turkeys in storage was reported. This does not include turkeys held in other than public warehouses. Eviscerated hen turkeys comprised 47.09% of the total classified stocks this year compared with 51.63% a year ago. Eviscerated tom turkeys totaled 48.17%—up from 41.89% in 1959. Eviscerated broiler-fryer type turkeys were 4.41%—down from 5.94% the previous year. New York dressed hen turkeys, 0.13%, (0.26% in 1959) and New York dressed tom turkeys, 0.20% (0.28% in 1959).

First Canadian Nitrogen Frozen Shipment

The first Canadian rail shipment of frozen foods utilizing the liquid nitrogen process arrived in Toronto during October. An entire carload consisting of 60,575 pounds of broccoli, cauliflower, raspberries and blackberries was loaded at Vancouver, British Columbia, October 5. The food was subjected to liquid nitrogen at minus 320F utilizing the liquefreeze process. The food was transported for a period of six days and a total of 3,000 miles without any additional refrigeration, mechanical or otherwise, enroute. Upon arrival at Toronto October 11, the average product temperature of the food was minus 53 degrees F. The shipment was made by Liquefreeze Corporation and cooperating were York Farms, a subsidiary of Canadian Packers, Limited, the Canadian National Railroad and International Equipment Company, Limited, of Montreal.

Pittsburgh Plate Glass Announces Polyether Foams

Pittsburgh Plate Glass Company has announced a two-package polyether foaming system for the production of rigid polyether foams to be known as Selectrofoam. The system contains the necessary chemical additives including a fluorocarbon blowing agent and eliminates the need of additional formulating before using. It is based upon PPGC's standard line of Selectrofoam for rigid uses. The new system is designed primarily for refrigeration applications.

ARI Publishes New Standards For Compressors

Two new standards for air-conditioning and refrigeration compressors and condensing units have been published by the Air-Conditioning and Refrigeration Institute, replacing six old standards. The new publications are ARI Standard 516-60, titled "Refrigerant 12 and Refrigerant 22 Compressors and Condensing Units, 25 Horsepower and Larger," and ARI Standard 511, "Ammonia Compressors and Compressor Units." Standard 516 was designed to replace Standard 5-21 and 5-22.

20 Million Cubic Feet Growth Per Year

According to the October 1, 1959 refrigerated warehouse survey made by the Crop Reporting Board of the Agricultural Marketing Service, the national capacity, excluding Alaska and Hawaii, totaled 942 million gross cubic feet. This was 41 million cubic feet more than the capacity on October 1, 1957. Except for meat-packers, all of the other types of refrigerated facilities reported capacity gains. The major increase, however, was in public general warehouse capacity—up 25 million to 528 million gross cubic feet. The reduction in meat-packing capacity reflects a trend that has prevailed for several years. With technological advances in meat curing, less refrigerated space is needed for storing these products.

Just prior to World War II, the national refrigerated capacity was primarily cooler (above 0 to 50 F.) space with a ratio of 6 cubic feet for each cubic foot of freezer space (0 F. and below). This ratio now is almost 1 to 1. Cooler capacity totaled 482 million cubic feet and freezer, 460 million cubic feet on October 1.

Freeze Drying Conference In France

The Second International Conference on Freeze Drying held in Lyon, France, August 29 to September 9, had representation from nearly 30 countries throughout the world. Purpose of the meeting was to explore the vacuum freeze-drying principle and its applications to meats, fruits, vegetables and seafoods. The International Institute of Refrigeration and the International Association of Microbiological Societies jointly sponsored the Conference.

Quick Freezing

By J. W. McLARAN,

General Manager, The Queensland Cold Storage Co-Operative Federation Limited, Brisbane, New Zealand

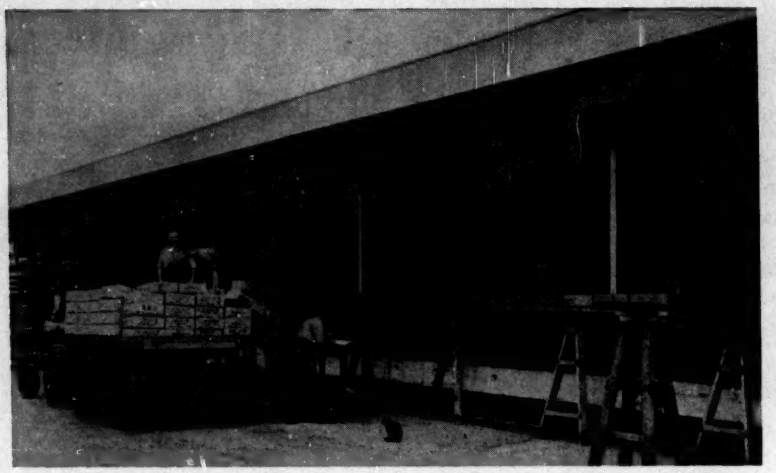

Fig. 1—Loading dock of Hamilton Cold Stores in Brisbane, New Zealand. The building contains 14 quick-freeze rooms with an entry from the loading dock. Note the steel frames and overhead rail on which packages are loaded for transfer to freezing rooms.

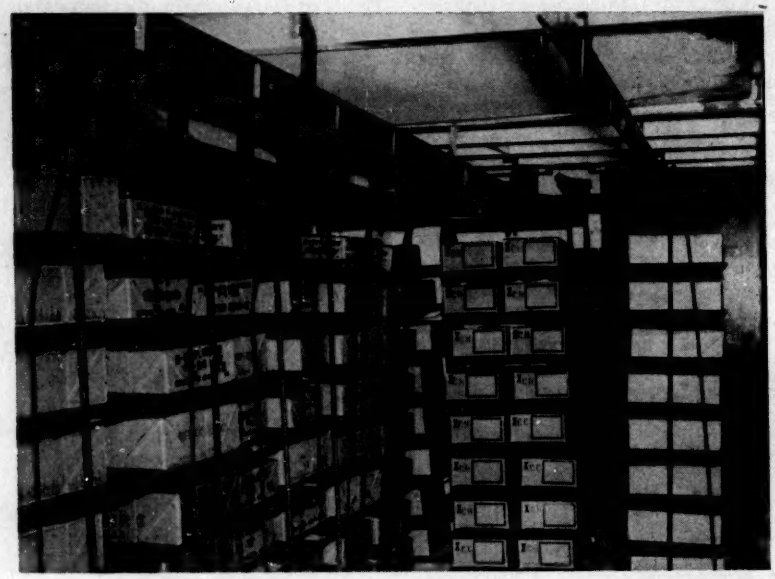

Fig. 2—A typical freezing room showing the 4" x 1/2" rails on which are suspended the steel frames constructed to form shelves for packages to be frozen. Frames permit 4" space between packages for good circulation. Each suspended frame holds 8 average cartons.

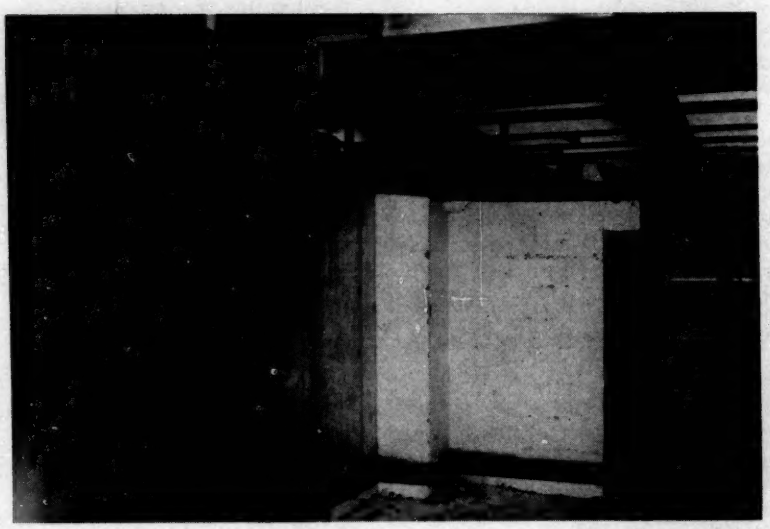

Fig. 3—Freezing rooms can be adapted to freezing quarter-beef simply by removing frames from the rails and replacing with hook rollers. Note that each room also has an entry to center passage running the length of the building. Rooms are unloaded through this passage.

Cartoned And Bone-In Beef

The present trend in the meat industry and other industries interested in edible, but perishable commodities, is towards precut and prepacked packages, ready for the consumers' table. This article deals with the problem of quick freezing such packages in the meat industry. It was originally an address given at the Commonwealth Cold Storage Association Annual Conference held in Adelaide, South Australia.

»» FOR the economic stability of any cold storage the absolute maximum of space in its rooms must be utilized. Chilled meat boned out and packed in cartons presents a difficult problem for the cold storage proprietor. Generally, the majority of meat operators have a standard type of pack for the various cuts, but the size of container is the problem associated with cold storage. Usually the meat is wrapped in polythene and the carton is waxed both inside and outside. The stores are then presented with a completely air tight block of meat where penetration to extract the heat is most difficult and naturally the heavier and thicker the package, the longer the process to freeze.

It is more or less common knowledge that no matter at what temperature meat is received into storage whether it be 40° or 60° within two days the temperature will drop to approximately 30°F and remain static for a further two or three days to break what we call the "Latent Heat Barrier". Once this hurdle has been overcome, the temperature will drop quite rapidly to 20°F and lower. This operation, apart from wasting space, causes a loss of time and greater handling costs. If these same cartons could be subjected to an extreme cold in the form of quick freeze tunnels on arrival, then it should follow that the work and consequently labor costs must be reduced, and the cold storage capacity increased.

Construction

The site for the quick freeze tunnels of the Hamilton Cold Stores in Brisbane, New Zealand, is on vacant land close to the river and adjacent to the main storage. Concrete piles were driven to a solid foundation approximately 19 ft. to 25 ft., and a steel reinforced concrete floor cast over the piles. The building took the shape of a rectangle (170 x 46 ft.) divided into sixteen sections and a loading platform. Fourteen quick freeze tunnels, a header room, and a passage running the length of the building connect each of the fifteen rooms.

Each freezing room was insulated with an 8-inch layer of cork on all walls, floors and ceilings, with the exception of the partitions dividing each room. Sheets of rigid foam were fitted in place bonded together with a sealing compound and faced with aluminum sheeting, giving each tunnel a total of 2,156 cu. ft. or 30,184 cu. ft. overall. (See Fig. 1)

Before the rooms were partitioned, fin coil flooded units of a capacity of 8 tons with two 23-inch axial fans giving 33,000 cubic feet of air per minute, and two 5 hp electric motors were bolted to the ceiling of each room with duct work placed so as to guide the blast in a circular motion through the rooms and back up again through the unit, thus giving complete air circulation. Steel rails 4-inch x ½-inch were suspended. from the ceiling to a height of 7 ft. 2 in. from the floor, three rails to each room running lengthwise with switches to connect each rail placed at both ends, and connected by a hinged length of rail to rails on the loading platform at one end, and in the passage at the other end. This rail system was so planned that every room is connected both to the platform and passage which in turn are connected by a rail running the width of the building. Insulated sliding doors were then fitted to each end of the rooms with two strips of a soft rubber bonded to the edge of the doorway completely sealing the rooms.

We have found through experience that steel frames made in such a way as to form shelves and suspended from the overhead rails by a roller form both a quick method of loading and an excellent means of allowing complete circulation to each carton which, when placed in the shelves and pushed along the rail into the freezing tunnel, automatically leave a space of about 4-in. between cartons. Each tray holds eight average cartons or 16 small ones, and each room accommodates 30 trays which makes 240 cartons per room, or 480 of the smaller size. Take an average sized carton as containing 80 lbs., the total capacity of freezing space is in the vicinity of 120 tons, or 600 tons for a five day week, or an output of 30,000 tons per year. Working around the clock seven days a week, we have 42,000 tons per annum, or 63,000 tons if the rooms were to contain all small cartons. (See Fig. 2).

Quarter Beef

The adaptability to convert to quarter-beef is quite simple, merely by using hook rollers instead of the frames. Unfortunately, we have not received any quarter-beef for the quick freeze tunnel to date, and consequently there are no figures available. (See Fig. 3).

When each room is filled, the doors are shut, the fans switched on, and the valves are adjusted in the header room. (See Fig. 4) On the doors of all rooms, a small blackboard has been placed on which is written the name of the client whose meat is in the room, and the time and date the fans were switched on. Care has to be taken that the fan blades are free before switching the motors on. This is done by a quick on-off before closing the door. Pilot lights are provided near the fan switches as a warning that the fans are running. Automatic cut-offs have been placed in the electrical system if any fan motor is overloaded.

Defrosting is a simple operation

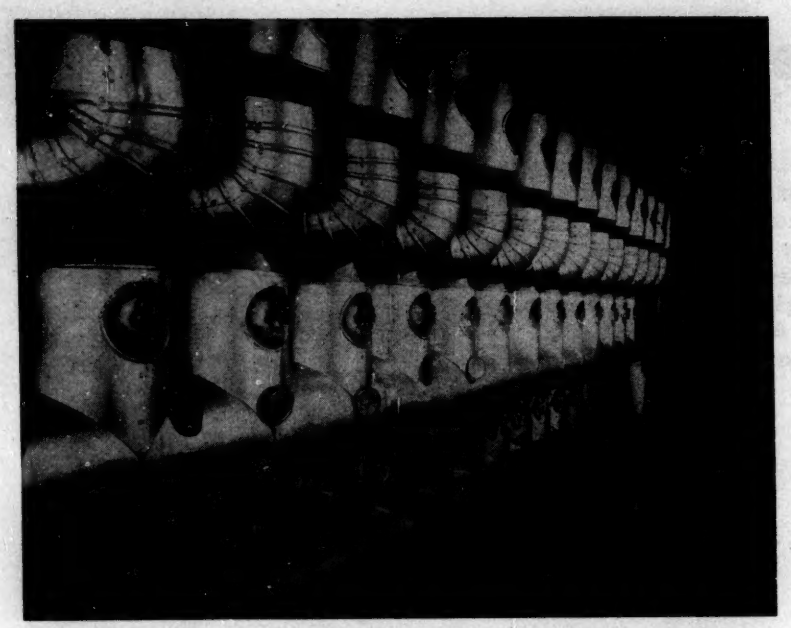

Fig. 4—The building contains a header room where refrigerant valves for each freezer room are located. The insulated headers and valves for each room are shown above. Valves are adjusted after room doors are closed.

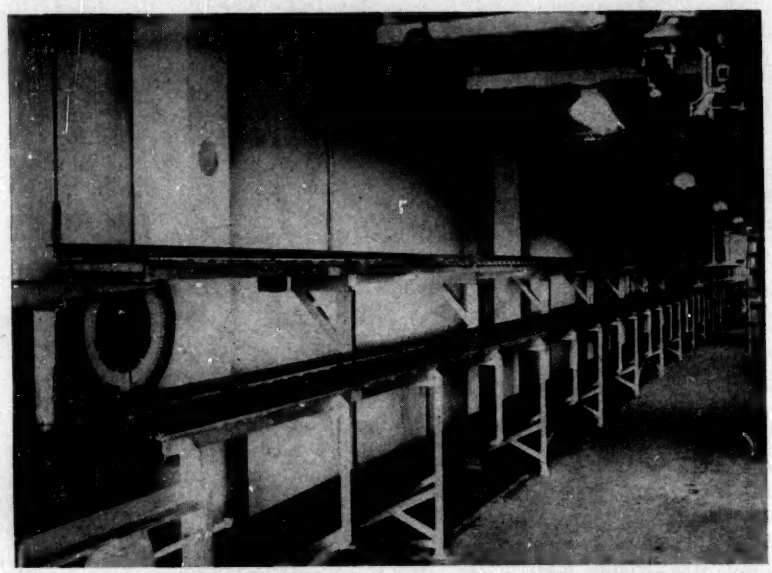

Fig. 5—A conveyor belt runs the length of the building through the passage facilitating the shipment or transfer of frozen packages.

Table I — Time-Temperature Of Packages

Time Elapse	Loading End	Center	Discharge
Initial Temperature	43°	50°	48°
5 hours	37°	36°	40°
10 hours	29°	28°	30°
15 hours	28°	24°	27°
20 hours	26°	18°	21°
25 hours	20°	—1.8°	3.2°

performed merely by subjecting the coils to a flow of water through a pipe installed above the unit. A tray underneath catches the run-off, which flows outside into a drain in the passage. The time taken to complete the defrosting is approximately 20 minutes.

When the meat is frozen and has reached a temperature below 20°F and is ready for stacking, the trays are pushed out into the passage and the cartons transferred to a conveyor, and go on their way to a designated room ready for shipping. (See Fig. 5 and 6).

Refrigeration System

A liquid recirculation system was installed separate to our existing recirculation system to supply the quick freezers, which are approximately 200 yards from the engine room. An additional surge drum was employed and the liquid returned by a gear pump, pumping 175 lbs. of liquid per minute. Naturally there are two stages of compression. The first is secured by two 75 ton rotary boosters operating on a suction temperature of -40° with between 17½ to 20 inches of vacuum. The hot gas is discharged up to a maximum of 300° F. into a desuperheater. This drum is necessary media between the rotary boosters and the main engine room second stage compression to break down the heat before discharging into the engine room header at 15 lbs. per sq. inch. The transference of heat in the desuperheater takes place where the hot gas enters from the top of the drum through a pipe which reaches almost to the bottom. The end was blanked off and perforations near the end allow the gas to escape into a level of liquid and so reduce the temperature approximately 3° or 4°F. Level masters with automatic alarm bells were fitted to both the surge drum and desuperheater. (See Fig. 7).

An 8-inch suction line insulated to 3½-inch was installed with 1½-inch liquor line and connected to the header room in the quick freeze block. Liquor temperature readings at the header room vary from -40° to -50°F. Electrical thermometers were fixed in each tunnel and wired to a recorder near the engine room where readings were logged every two hours.

Table 2—Relation Of Freezing Time To Carton Size

Carton Thickness	Pounds Weight	Freezing Time Hrs.
4"	50-60	12-15
5"	65-70	18-22
6"	70-100	22-27

Table 3

"A" Capacity	8 tons
Filled 12 noon	+30°F
Fans on 1:20 pm.	−23°F
4:00 pm.	−28°F
6:00 pm.	−28°F
8:00 pm.	−30°F
10:00 pm.	−33°F
Midnight	−35°F
2:00 am.	−37°F
6:00 am.	−39°F
8:00 am.	−39°F
10:00 am.	−39°F
Noon—fan off	−36°F
2:00 pm.	−36°F

"B" Capacity	8 tons
Filled 10:00 am.	+21°F
Fans on 11:20 am.	− 8°F
2:00 pm.	−26°F
4:00 pm.	−30°F
6:00 pm.	−32°F
9:00 pm.	−34°F
10:00 pm.	−37°F
Midnight	−39°F
2:00 am.	−41°F
4:00 am.	−42°F
6:00 am.	−43°F
8:00 am.	−44°F
10:00 am.	−45°F

"A" 1 sample carton 80 lbs. 15°F
"B" 1 sample carton 80 lbs. 13°F

Results

Various tests have been carried out to determine the time that the meat takes to freeze. The Department of Agriculture & Stock in Queensland performed an initial trial on 14 cartons, average weight 80 lbs., with the aid of thermocouples and found a variation in temperatures throughout the particular tunnel as shown in Table 1.

Further tests have since been carried out with thermometers, and the data in Table 2 was recorded.

From these examples a tunnel loaded at 10:00 am. can be safely unloaded on the following day between 9:00 am. and 12 noon.

Air temperature readings extracted from the log book for two rooms which we will call "A" and "B", were as listed in Table 3.

Labor, the all important cost of any business was carefully watched, and after a modification or two a fixed number of employees were allocated to perform the necessary duties.

An interesting fact has arisen from the power consumption of the rotary boosters together with the fan motors. Over a period of four weeks, the total production was 2,178,294 lbs. or approximately 972½ tons. The power consumption

Continued on page 32

Fig. 6—When packages have reached a temperature of below 20 degrees and are ready for stacking, trays are pushed into the central passage and cartons transferred to the above conveyor and may be shipped immediately or sent to a holding room awaiting shipment.

Fig. 7—The quick-freezer rooms are about 200 yards from the main engine room. The above surge drum, liquid return gear pump and two 75-ton rotary boosters in a liquid recirculation system were added to supply the 14 freezers.

By COLE G. CAMPBELL
Western Regional Service Engineer, Carrier Corporation.

The application engineer and the operating engineer look at a proposed piping installation from two slightly different points of view. The application engineer is responsible for the job design. He lays out the piping to incorporate the best information he has available on good piping practice, then he is supposed to be finished with the job. When the operating engineer looks at a piping diagram, he should try to spot the "headaches" which may develop and which he has to live with until they are corrected. Therefore the subject of this article could be: "What parts should be checked in a proposed refrigeration piping diagram for potential trouble?"

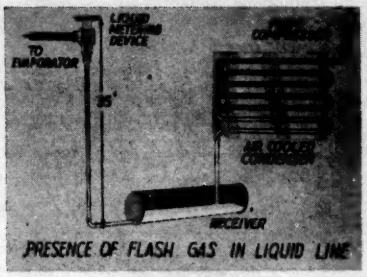

Fig. 1

Good Piping Practice

»» IN REFERRING to certain items of equipment in this discourse, it should be recognized that any trouble experienced is often due directly to malfunctioning of the devices themselves. However, this analysis of trouble with a particular piece of equipment is confined to possible faults in the piping. We will begin with liquid lines.

The following factors are of primary importance in designing liquid lines:

1. The liquid line should be sized for a practical pressure drop due to friction in passing through accessories. Shut off valves, driers, strainers, solenoid valves, etc., should be properly sized to prevent excessive pressure drop.
2. Precautions should be taken to prevent flash gas in the liquid line.
3. Metering devices should be properly sized.
4. Location of the system components should be carefully considered to prevent siphoning and to insure proper distribution of refrigerant.

The liquid line should normally be sized for a pressure drop not exceeding 3 or 4 pounds per square inch in Refrigerant 21 or 22 systems. This is equivalent to approximately 2 degrees drop in saturation temperature.

Fig. 1 shows a system in which there is no liquid sub-cooling and therefore, flash gas has occurred because of liquid lift or any incorrectly sized line.

Refrigerant remains in liquid form only as long as its temperature is at or below the saturation temperature corresponding to the liquid pressure. If the liquid is slightly sub-cooled, either an increase in liquid temperature or a decrease in liquid pressure will cause some of the refrigerant to flash into gas.

The presence of flash gas in the liquid line has several detrimental effects:

1. It increases the pressure drop due to friction, and this, in turn, causes further flashing.
2. It reduces the capacity of the liquid metering device, and starves the evaporator unless the device is purposely over-sized to handle the expected amount of flash gas.
3. It causes erosion of the valve pin and seat, and creates a noticeable noise as it passes through the metering device.
4. It causes erratic control of the liquid refrigerant entering the evaporator.

In consideration of these potential difficulties, it is apparent that the liquid line should be designed so that the liquid entering the liquid metering device is slightly sub-cooled, and troublesome flash gas is eliminated.

With a noticeable friction drop or a static head, due to elevation of the liquid metering device above the condenser, it is necessary to resort to some means of sub-cooling to prevent flashing in the liquid line. This is usually done in one or both of two ways:

1. By the use of a liquid-suction heat interchanger.
2. By use of liquid sub-cooling coils in the evaporator condenser.

The determination of how much liquid sub-cooling is required to offset friction and static head losses is quite simple. At normal liquid temperatures, the static pressure loss due to elevation at the top of a liquid lift is equal to one psi for every 1.8 feet of Refrigerant 12 and 2.0 feet of Refrigerant 22. Note the 35 ft. liquid lift and the 100 F receiver temperature in Fig. 1. These figures will be used as the basis for an example.

Let us assume a Refrigerant 12 system having a condensing temperature of 100 F, a liquid lift of 35 feet, a piping friction loss of 3 psi and additional losses through valves and accessories amounting to 7.4 psi.

Here is calculated the amount of liquid sub-cooling required under these conditions.

Pressure loss due to pipe friction	—	3.0 psi
Pressure loss due to valve, etc.	—	7.4 psi
Pressure loss due to 35 foot liquid lift 35/1.8	—	19.5 psi
Total pressure loss	—	29.9 psi
Condensing pressure (at 100 F.)	—	116.9 psig
Net pressure at liquid feed valve 116.9–29.9	—	87.0 psig
The saturation temperatures at 87.0 psig	—	82.0 F.

Fig. 2

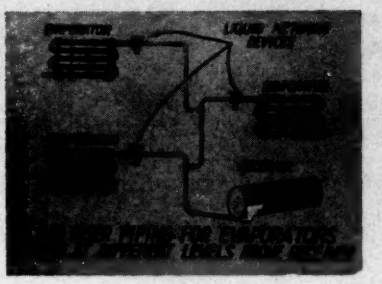

Fig. 3

Fig. 4

For Refrigerating Systems

The sub-cooling required is equal to the condensing temperature minus the saturation temperature at 87 psi gauge, or 100 –82 = 18 F. Therefore, the liquid subcooling required to prevent liquid flashing is 18 degrees F.

The pressure differential available across the liquid metering device has a considerable effect on its capacity to feed the evaporator. For example, let us consider the capacity of a given expansion valve in two similar systems operating at the same evaporating temperature but at different condensing temperatures.

The following conditions are assumed:

	CASE I	CASE II
Suction temperature	40 F	40 F
Condensing temperature	105 F	90 F
Press. drop in liquid line	4 psi	4 psi
Loss of head due to liquid lift	30 psi	30 psi
Pressure drop through evaporator	8 psi	8 psi

It can surely be seen here that, for a given refrigeration load, a different size valve is indicated for one system as compared to the other. It can also be seen that neither system comes close to providing the 60 psi differential across the valve that is considered standard in the industry for setting the ratings of expansion valves.

Find pressure at valve inlet:	Case I	Case II
Condensing Temperature	105 F.	90 F.
Condensing Pressure	126.2 psig	99.6 psig
Less pressure drop in liquid line	4.0 psi	4.0 psi
Less loss of head due to liquid lift	30.0 psi	30.0 psi
Net pressure at valve inlet	92.2 psig	65.6 psig

Find pressure at valve outlet:	Case I	Case II
Pressure at evaporator outlet	37.0 psig	37.0 psig
Plus pressure drop through evap.	8.0 psi	8.0 psi
Net pressure at valve outlet	45.0 psig	45.0 psig

Find pressure difference across valve:	Case I	Case II
Net pressure at valve inlet	92.2 psig	65.6 psig
Net pressure at valve outlet	45.0 psig	45.0 psig
Pressure difference across valve	47.2 psi	20.6 psi

Case I –At 47.2 psi, actual capacity of nominal 50* ton valves is 45.0 tons
Case II–At 20.6 psi, actual capacity of nominal 50* ton valves is 31 tons

**Rated at 40 F. suction, 60 psi pressure difference*

Where the condenser or receiver is located above the evaporator as in Fig. 2 it is recommended that the liquid line be looped upward at least six feet. The loop is to prevent siphoning of liquid into the evaporator during shutdown, as the result of a leaky metering devise, or the use of a liquid-charged expansion valve which may be open during shutdown.

Where the evaporators are located at different levels above the receiver as in Fig. 3 the liquid riser should be properly designed to apportion equally to all evaporators any flash gas that may develop in the riser.

Sometimes when it is necessary to install a liquid riser of over 25 feet, it may be difficult to prevent gas flashing as a result of the pressure reduction due to elevation. This condition will, of course, result in poor performance and loss of capacity at the expansion devices. To make it worse it also causes unequal distribution of liquid refrigerant because the uppermost evaporators get most of the flash gas.

The liquid riser arrangement

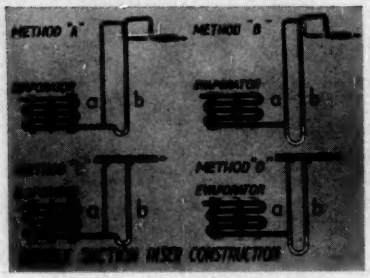

Fig. 5

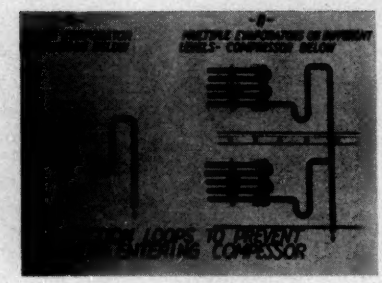

Fig. 6

Fig. 7

shown in Fig. 3 helps to correct this situation. Flash gas formed in each section of the riser will tend to go to the nearest evaporator. This will help prevent the uppermost evaporator from getting all of the flash gas developing in the riser.

Suction Lines

Suction lines are the most critical from a design and construction standpoint. These are the major things to consider in laying out or checking the design of a refrigerant suction line:

1. The suction line should be sized for a practical pressure drop at full load.
2. The suction line should be designed to return oil from the evaporator to the compressor under minimum load conditions.
3. The suction lines should be designed to prevent liquid from draining into the compressor during shutdown.
4. The suction line should be designed so oil from an active evaporator does not drain in an idle evaporator.

Pressure drop in the suction line means a loss in system capacity because it forces the compressor to operate at a lower suction pressure to maintain the desired evaporating temperature in the coil.

Suction lines are normally sized for a total pressure drop equivalent to about 2 degrees change in saturation temperature.

Most refrigeration piping systems contain a suction riser either by reason of the relative location of the evaporator and compressor, or because the riser is introduced for the purpose of minimizing the possibility of liquid returning from the evaporator to the compressor as shown in Fig. 4.

Oil is lost from reciprocating machines during normal operation, because these machines are designed so that the pistons and piston rings ride on a film of oil while traversing the cylinder. A small quantity of this oil is continuously pushed on through the cylinders and out with the discharge gas.

Since it is inevitable that oil will leave the compressor with the refrigerant, means must be provided for returning this oil at the same rate at which it leaves.

Oil which leaves the compressor reaches the condenser and there becomes dissolved with the liquid refrigerant. In this condition it readily passes through the liquid supply lines to the evaporators. In the evaporator, however, a distillation process occurs and there is almost a complete separation of the oil and refrigerant. Very little oil can remain in the relatively cold and less dense refrigerant vapor at the temperature and pressure corresponding to its evaporating condition. Therefore, the oil which is separated in the evaporator can be returned only by gravity or by entrainment with the returning gas.

The principle criteria determining whether or not oil can be entrained and thereby carried up a suction riser are; the gas velocity, the gas density and the pipe diameter.

Tables have been prepared for Refrigerant 12, Refrigerant 22 and other refrigerants containing the necessary data to permit accurate and rapid selection of the suction line size which will permit oil return up vertical risers under any given operating condition.

Table 1 shows a suction riser sizing table for Refrigerant 12. Depending on the suction temperature at which a system is operating, this table shows the minimum tonnage at which oil will return up a vertical suction rise for any size pipe.

Take for example a 12 ton job operating at 40 F suction. It can be seen from this chart that a 2⅝" suction riser can be used as it will return oil satisfactorily down to 9.7 tons. The "F" represents the friction drop equivalent in degrees for 100 feet of pipe.

Suction risers must be sized for minimum system capacity.

It is extremely important that oil be returned to the compressor at the operating condition corresponding to the minimum displacement and minimum suction temperature at which the compressor will operate.

For compressors with capacity control, the minimum capacity is represented by the lowest capacity at which the compressor can operate. It is important in the case of multiple compressors with capacity control. The minimum capacity here is the lowest capacity at which the last operating compressor can run.

Double Suction Risers

Because modern compressors have capacity reduction features, it often becomes difficult to maintain the gas velocities required to return oil upward through vertical suction risers.

When the suction riser is sized to permit oil return at the minimum operating capacity of the system, pressure drop in this portion of the line will be relatively large when operating at full load.

If a correctly sized suction riser imposes too great a pressure drop at full load, it is possible to eliminate this problem through the use of a double suction riser.

Fig. 5 shows typical double suction riser construction. Oil return is accomplished with this device at minimum loads, while not imposing the penalty of excessive pressure drop at full load. Let us

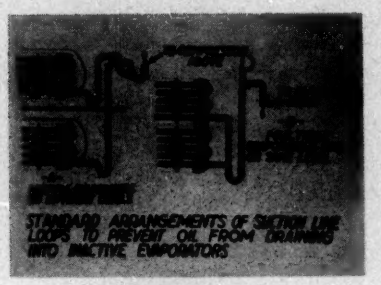

Fig. 8

take a look at the design and operation of a double suction riser:

1. The small risers, indicated by "a" in the figure, are sized so that they will return oil at the minimum load which can occur.
2. The second riser "b", which is usually larger but not necessarily so, is sized so that the pressure drop through both risers at full load is satisfactory. The usual method here is to size the second riser "b" so that the combined cross sectional area of "a" and "b" is equal to the cross sectional area of a single pipe, which would be required for oil return in an upward flow riser, under maximum load conditions.
3. A trap is introduced between the two risers as shown in the figures. During partial load operation where the gas velocity is not sufficient to return oil through the risers, the trap will gradually fill up with oil until the second riser "b" is sealed off. The gas then travels up riser "a" only and now has enough velocity to carry oil along with it, back into the horizontal suction main.

As illustrated in the diagrams, precaution should be taken to close-couple the fittings at the bottom of the risers, so that the oil holding capacity of the trap will be limited to a minimum.

Also note in methods "A" and "B" that both risers form a loop at the top before entering the horizontal suction line. The purpose of this is to prevent oil drainage into an idle riser at partial load.

The alternate arrangement shown in methods "C" and "D" can also be used where both risers are smaller than the common suction line. The use of reducing fittings. in this case will serve as a trap to prevent oil draining into an idle riser.

Table 1—Suction Riser Sizing For Oil Return (Refrigerant 12)

	Copper Tubing—Gov't Type "L"							
O. D. Pipe Size	2-1/8"		2-5/8"		3-1/8"		3-5/8"	
Area Sq. In.	3.094		4.770		6.812		9.213	
Suct. Temp.	T	F	T	F	T	F	T	F
–40	2.5	1.4	4.3	1.3	6.7	1.3	9.8	1.2
–20	3.2	.8	5.5	.8	8.5	.7	12.4	.7
0	3.9	.5	6.7	.5	10.5	.5	15.2	.4
20	4.7	.3	8.1	.3	12.7	.3	18.5	.3
40	5.6	.2	9.7	.2	15.1	.2	22.0	.2

F = Friction Drop °F/100' *T = Tons Refrigeration*

The remaining portions of the suction line may be sized to permit a practical pressure drop between the evaporators and compressors, since oil will be carried along in horizontal lines at relatively low gas velocities. It is good practice to give a slight pitch to these lines toward the compressor, whenever possible. Traps should be avoided, but if unavoidable, risers from these traps must be treated in the same manner as those leading from the evaporators.

The suction line should be designed to prevent liquid from draining into the compressor during shutdown.

Certain standard piping practices have been developed to serve this purpose.

Diagram "A", Fig. 6, represents the case where the compressor is below a single evaporator. A loop rising to the top of the evaporator should be made in the suction line, to prevent liquid refrigerant from draining into the compressor during shutdown.

Diagram "B" shows multiple evaporators on different floor levels with the compressor below. Each individual suction line should be looped to the top of the evaporator before being connected into the suction main, to prevent liquid from draining into the compressor during shutdown.

Diagram "C", Fig. 7, has multiple evaporators stacked on the same floor level with the compressor below. This is similar to the previous figure, except that here it is possible to use one loop to serve the purpose.

In Diagram "D", Fig. 7, multiple evaporators are located on the same level and the compressor is located below. The common suction line will prevent draining of the evaporators into the compressor on the off cycle.

The suction lines should be designed so that oil from an active evaporator does not drain into an idle evaporator.

Diagram "A", in Fig. 8, shows multiple evaporators on different floor levels and the compressor above. Each suction line is brought upward and looped into the top of the common suction line. This prevents oil from draining down into either coil that may be inactive.

Also, note the small loop in the suction line leaving each evaporator. The purpose of this loop is to provide free drainage away from the thermostatic expansion valve bulb.

Diagram "B", Fig. 8, shows multiple evaporators stacked with the compressor above. Oil is prevented from draining into the lowest evaporator because the common suction line drops below the outlet of the lowest evaporator before entering the suction riser.

In diagram "C", Fig. 9, multiple evaporators are shown on the same level and the compressor is located below. The suction line from each evaporator enters horizontally into the common suction line. Each branch line must be smaller than the suction main so that oil cannot drain into an idle evaporator. An alternate arrangement is shown in "D", for cases where the compressor is above.

Hot Gas Lines

With self-contained condensing units, the design of hot gas lines is

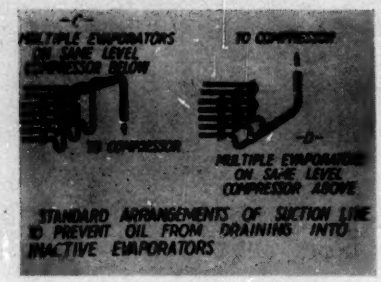
MULTIPLE EVAPORATORS ON SAME LEVEL COMPRESSOR BELOW
TO COMPRESSOR
TO COMPRESSOR
MULTIPLE EVAPORATORS ON SAME LEVEL COMPRESSOR ABOVE
STANDARD ARRANGEMENTS OF SUCTION LINE TO PREVENT OIL FROM DRAINING INTO INACTIVE EVAPORATORS

Fig. 9

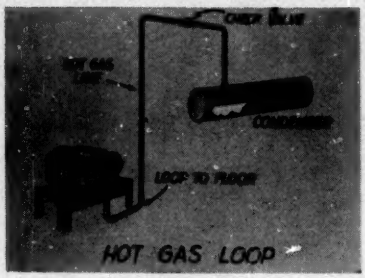

Fig. 10

Fig. 11

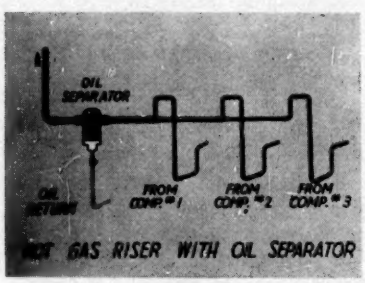

Fig. 12

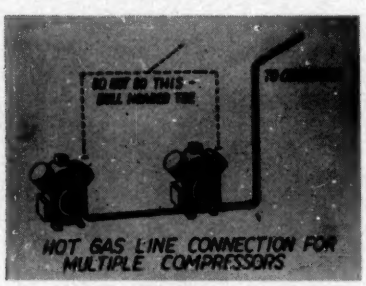

Fig. 13

not a problem, inasmuch as they are completely assembled at the factory. In the case of remotely located condensers, however, the hot gas line must be properly designed as part of the system.

There are definite things to consider when designing or checking a hot gas line:

1. The hot gas line should be sized for a practical pressure drop.
2. The hot gas line should be designed to prevent refrigerant from condensing and draining back to the head of the compressor.
3. The hot gas line should be designed to avoid trapping oil at partial load operation.
4. Connections of multiple compressors to a common hot gas line should be carefully chosen and designed.

It is important to minimize the pressure loss in hot gas lines because losses in these lines increase the required compressor horsepower per ton of refrigeration, and decrease the compressor capacity. It is usual practice not to exceed a pressure drop, corresponding to about two degrees change in saturated temperature.

Table 2 illustrates the effect of suction and hot gas line pressure drops on compressor capacity and horsepower for two different levels of operation: air conditioning and refrigeration. Let us compare the capacity and horsepower per ton at the two different levels as the result of the line loss as shown.

With zero degrees line loss, the capacity and horsepower per ton are at 100% for both air conditioning and refrigeration. With a 2 degree line loss, the air conditioning capacity decreases to 96.9% and the horsepower per ton increases to 104.9%. Similarly, the refrigeration capacity decreases to 93.0% and the horsepower per ton increases to 104.0%.

With 4 degrees line loss, the capacity further decreases and the horsepower per ton increases, as indicated by the figure on the chart.

Whenever the condenser is located above the compressor, as in Fig. 10, the hot gas line should loop to the floor near the compressor before rising to the condenser. This prevents the possibility of refrigerant condensing and draining back to the head of the compressor. The loop in the hot gas line will serve as a reservoir and trap any liquid resulting from condensation in the line during shutdown.

Whenever the condenser and receiver are located where the ambient temperature can be higher than that of the compressor, a check valve should be installed in the hot gas line near the condenser. This will prevent condensation of refrigerant in the compressor.

Even though a low loss is desired in hot gas lines, they should not be oversized to the extent that gas velocities are reduced to a point where the refrigerant will not be able to carry along any entrained oil. In the usual application this will not be a problem in hot gas line. However, in the case of multiple compressors with capacity control, it is wise to make sure any hot gas risers will carry oil along at all possible loadings.

Sometimes in installations of multiple compressors having capacity control, a vertical hot gas line sized to entrain oil at minimum load has an excessive pressure drop at maximum load. When this problem exists, one of two things can be done.

A double hot gas riser can be used in the same manner as it is used in a suction line.

Fig. 11 shows the double riser principle applied to a hot gas line. Note the pressure of the discharge line loop to prevent liquid or oil from draining back to the heads of the compressors during off cycles.

As an alternate, the hot gas riser can be sized for a normal pressure drop if an oil separator is installed before entering the riser as in Fig. 12.

Location of the oil separator at this point results in catching practically all of the oil and returning it to the compressors. Any oil draining back down the riser, under light load or on shutdown, would accumulate in the oil separator. Certain precautions must be taken with this type of arrangement. They will be discussed later under "oil separators".

In all cases, horizontal lines should be pitched downward in the direction of the gas flow to facilitate the travel of oil through the system and back to the compressor.

In connecting multiple compressors to a common hot gas line, certain precautions must be observed.

1. The proper method of joining the hot gas lines from multiple compressors is shown in Fig. 13 by solid lines.
2. Tees should never be piped so that they result in a "bull-head" connection. The dotted lines show such a "bull-head" connection in the discharge lines from two compressors. The turbulence caused by "bull-heading" tees adds greatly to the pressure drop, and also induces hammering in the line.
3. Hot gas line branches at the compressors should not allow oil to drain back to the discharge valves of an idle compressor when only one machine is operating. The broken lines in Fig. 13 will do just that. Oil leaving the operating compressor will be thrown into the branch line from the idle compressor and drain down into that machine.

When compressors are connected in parallel, it is important that operating pressure of each be as nearly alike as possible.

Fig. 14 shows interconnecting suction and hot gas lines for two compressors. If three compressors are interconnected, they could be handled as shown by the broken lines.

The suction header between points "A" and "B" should always be level. Suction lines from this header to each compressor should be taken off in the horizontal plane. This prevents oil from draining into an idle compressor.

The compressors should be placed on foundations so that all crankcase oil equalizer connections are exactly level.

An interconnecting oil equalizing line should connect all the crankcases, to maintain uniform oil levels in all machines. It is usually run as shown in Fig. 15 but under no condition should it be run at a level higher than that of the crankcase connections.

For the oil equalizer line to work successfully, it is necessary to equalize the crankcase pressures. This is accomplished through the use of a gas equalizer line which is installed above the oil level. This line may be run as shown in Fig. 15 to provide head room or run level with the tappings on the compressors. It should be piped so that oil or condensed vapor will not be trapped.

Both lines should be the same size as the tappings on the largest compressor and should be valved so that any one machine can be taken out for repair without shutting down the entire system.

When the multiple condensing units are interconnected as shown, it is also necessary to equalize the pressure in the condensers to prevent hot gas from blowing through one of the condensers and into the liquid line. To do this, install a hot gas equalizer as shown in Fig. 15. If the piping is looped as shown, vibration should not be a problem. The botoms of all condensers should be at the same level to prevent backing liquid into the lowest one.

Condenser to Receiver Piping

Liquid piping between the condenser and receiver should be designed to prevent liquid hold-up in the condenser due to a gas-bound receiver.

This usually occurs when the receiver ambient temperature is above condensing temperature.

This may happen as the result of any one of several conditions:

1. On evaporative condensers:
   (a) Where low prevailing wet-bulb temperatures result in low condensing temperatures.
   (b) Where they are oversized for dry-coil operation.
   (c) Where no provision is made to control the supply air automatically at partial load operation.

Turn to page 22

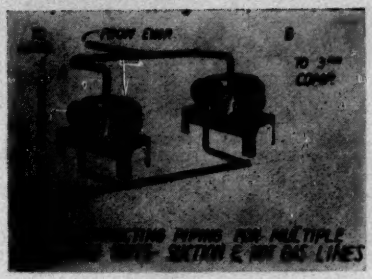

Fig. 14

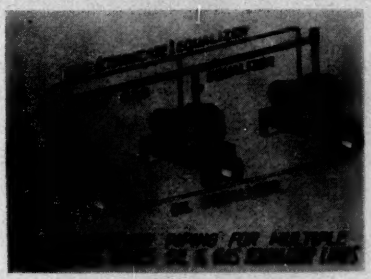

Fig. 15

Fig. 16

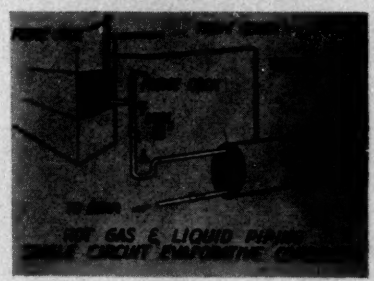

Fig. 17

Table 2–Effect of Pipe Sizing On System Capacity

Design Conditions	Air Conditioning		Refrigeration	
Suction Temp.	40°		–30	
Line Size*	1⅝"		3⅛"	
Line Loss	Capacity	HP/Ton	Capacity	HP/Ton
0° Line Loss	100%	100%	100%	100%
2° Suction 2° Hot Gas	96.9	104.9	93.0	104.0
4° Suction 4° Hot Gas	93.6	109.4	86.5	108.0

**For 10 Ton load & 75 ft. equivalent length of pipe*

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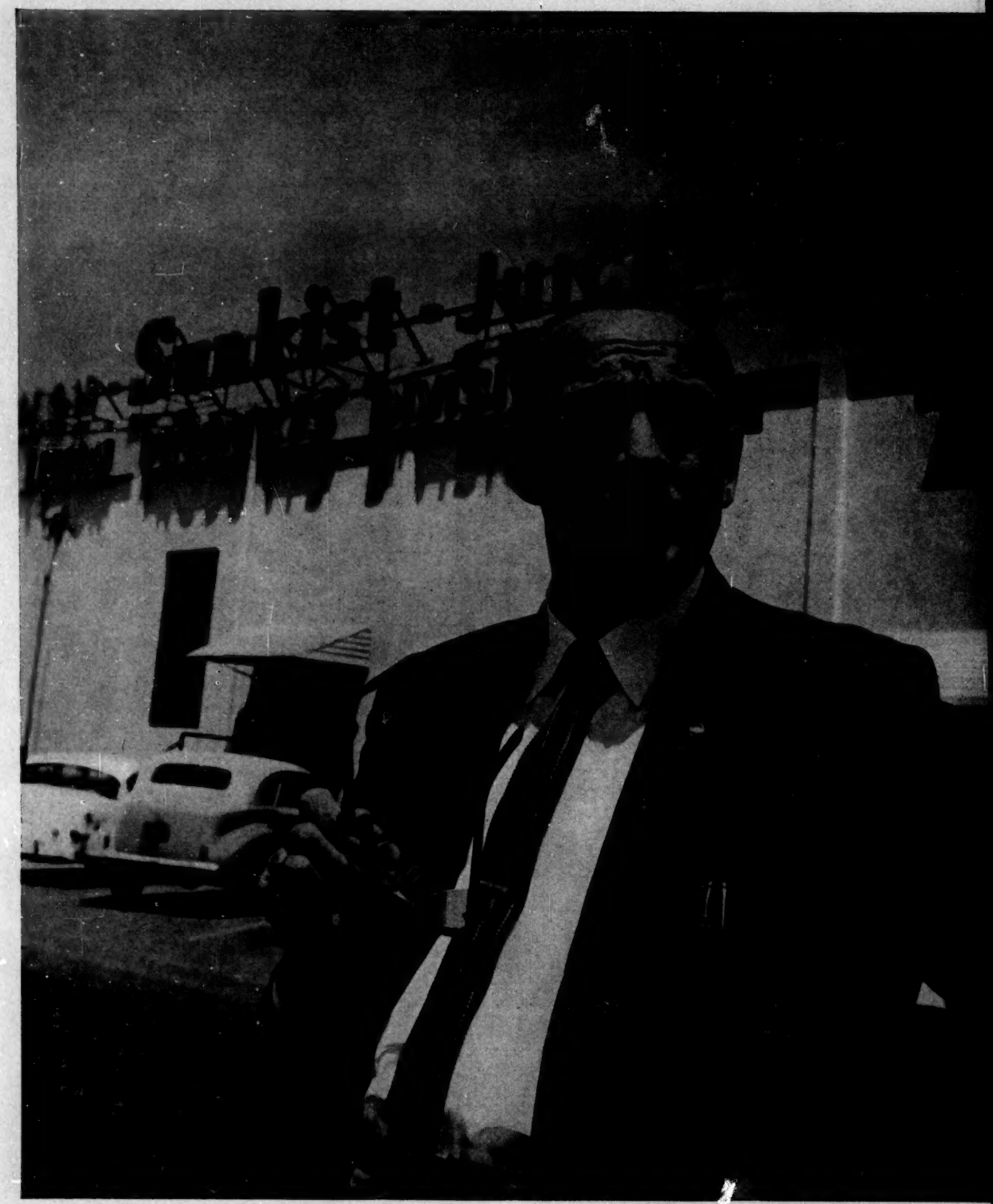

James S. Hutchison, chief engineer for Lemon Products Division, Sunkist Growers, who utilized nearly 400,000 board-feet of Styrofoam in a new warehouse at Corona, California.

STYROFOAM®

Approved Insulation Contractor relieves Sunkist of detail on low-temp installation for new warehouse

"Styrofoam*, installed by a Dow Approved Insulation Contractor," reports James S. Hutchison, chief engineer for the Lemon Products Division, Sunkist Growers, "gives us the advantages of a permanent, moisture-sealed, maintenance-free insulation job." The AIC, Los Angeles Cork Company, installed nearly 400,000 board-feet of Styrofoam in a new warehouse that's so large it can hold enough frozen concentrate to make a four-ounce glass of lemonade for every U.S. citizen.

"Having an AIC do the job meant that we didn't have to spend expensive engineering time to 'nursemaid' the project," Mr. Hutchison points out. "Then too, the inspectors which Dow provided undoubtedly were much more familiar with this type of construction than we. In short, we were relieved of maintaining a time-consuming, laborious inspection program, without risking any defects in workmanship."

As Sunkist found out from first-hand testing, neither water nor water vapor penetrates Styrofoam, which makes its high insulating efficiency (low "K" factor) *permanent*. "Competitive insulating materials were checked for their resistance to vapor passage," Mr. Hutchison reports. "We couldn't even get a pressure drop through the Styrofoam."

As Sunkist discovered by careful investigation of insulation materials and contractors, the AIC certificate is awarded by Dow only to carefully selected contractors capable of providing technical design assistance, followed by expert installation. Los Angeles Cork Company is typical of more than 90 Approved Insulation Contractors located throughout the country. For the names of the ones nearest you, write THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Department 1642BU11.

*Dow's registered trademark for its expanded polystyrene

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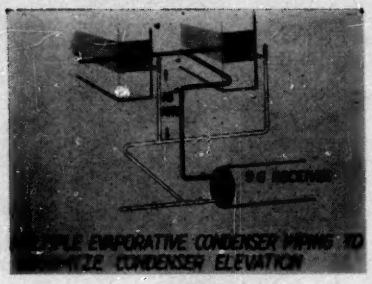


Fig. 18

Fig. 19

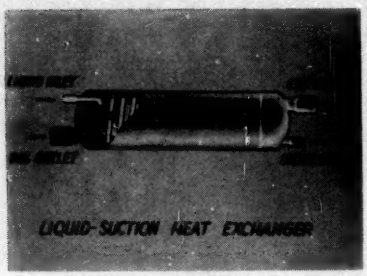


Fig. 20

Fig. 21

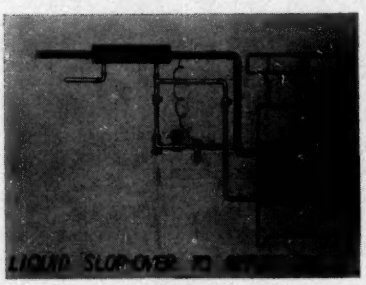


Fig. 22

2. On water-cooled condensers:
   (a) Where the low water supply temperature makes it economical to design for low condensing temperatures.
   (b) Where no provision is made to control the flow of water automatically, particularly at partial load operation.
3. On receivers where it is necessary to install them in abnormally warm locations.

In whichever way it occurs, the higher pressure in the receiver causes the liquid to hold up in the condenser.

When any of these conditions conducive to liquid holdup prevail, either of two piping arrangements can be used to equalize pressures, depending on the specific job conditions.

In Fig. 16, the liquid drain line is the same size as the hot gas line. Note that traps have been avoided. This is essential for proper operation.

The valve should be installed in the vertical portion of the drain line as shown. If it is necessary to install it in the horizontal portion of the drain line, the valve stem should be horizontal to avoid trapping.

With this piping arrangement, the vertical distance between the condenser oulet and the receiver inlet is not critical so long as the receiver is below the condenser outlet. This piping method is normally used with one single-circuit condenser.

In Fig. 17, a vent line is installed from the top of the receiver to the top of the condenser for relief of any flash gas formed in the receiver.

When the vent line is used, the minimum vertical distance between the condenser outlet and receiver inlet is critical. It should not be less than 18 inches as shown by the dimension arrows. The purpose of this liquid leg is to offset the friction drop through the coil. Venting flash gas from the receiver to the condenser inlet in this manner is practical only when low pressure drop condenser coils are used.

Fig. 17 also illustrates the proper location of the purge cocks to permit purging of non-condensables from the system.

During operation, it is expected that the richest area of non-condensables, if any are present, will be at the outlet of the evaporative condenser, or the top of the water cooled condenser. With the liquid drain trap as shown it is impossible for non-condensables to get to the receiver. Hence there is no reason to purge at the receiver.

The purge fittings should be full sized tees. Out of the top of the tees should run full sized nipples about 10 or 12 inches high. The purge valves should be located on top of the nipples, which act as air collecting chambers.

The purge cock in the liquid drain line should be used for purging during operation.

The purge cock in the high point of the hot gas line should be used for purging only after the system has been shut down. Before purging, sufficient shut-down time should elapse to allow non-condensables to collect at the top of the coil.

In Fig. 18, the receiver is used simply as a surge tank, the condensate line from the condenser being connected directly into the liquid line leaving the receiver. This arrangement provides somewhat more available head in the condensate drain line and is useful where it is otherwise impractical to achieve the 18 to 24 inch minimum distance between condenser outlet and receiver inlet.

Liquid flow from multi-circuit or interconnected condensers sometimes become erratic because of unequal condensing rates or other circumstances that result in unequal pressure drops in the various circuits. This may result in gas blow-through to the main liquid line, gas binding of the receiver, and a raised liquid level in one or more of the condensers.

Piping practices to overcome these effects are illustrated in Fig. 19.

Here, the drain lines from the condensers drop as far as possible; at least 18 inches, before joining in a common header, to compensate for pressure differences. The purpose of the trap ahead of the receiver is twofold:

1. It prevents gas in the receiver from backing up into the liquid drain line, when a vent line is used.

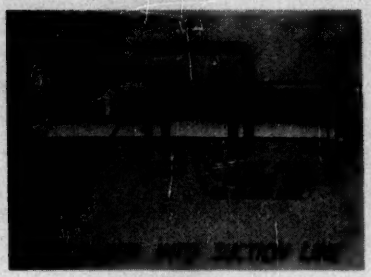


Fig. 23

Fig. 24

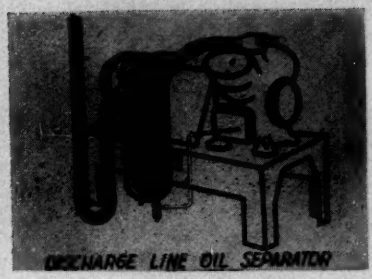


Fig. 25

2. It forms a seal in the liquid legs from each condenser, thus tending to eliminate gas blow-through from any unit due to slightly unequal condensing pressures.

Liquid-suction heat exchangers, Fig. 20, subcool the liquid refrigerant and in so doing superheat the suction gas.

Heat exchangers are used to increase the efficiency of the refrigeration cycle. This effect is greatest at low suction temperatures. For systems operating in the air conditioning range, they are usually not justified on the basis of increased cycle efficiency. The interchanger location for this purpose is unimportant. It can be located wherever convenient. The liquid-suction interchanger also subcools liquid refrigerant for the prevention of flash gas in the liquid line.

This is necessary when excessive pressure drops are present in the liquid line because of friction losses in the piping and liquid lifts to evaporators above receivers. This subject was covered under the discussion of liquid lines. The recommended location for this purpose is near the condenser or receiver, to achieve subcooling before the pressure drop takes place.

Another purpose of the liquid-suction heat exchanger is to vaporize liquid which slops over from the evaporator either intentionally or otherwise.

Several types of liquid suction heat exchangers are available on the market. Two general types will be discussed to show their applications.

The shell and coil or shell and tube exchanger is used to increase cycle efficiency and for liquid subcooling. Fig. 20 is the shell and coil type. These two types are suitable for the first two purposes but are not particularly good for cleaning up slopover. These units must be installed so that the suction outlet drains the shell, to prevent oil trapping.

The triple pipe exchanger, Fig. 21, is more suitable for cleaning up slopover. However, it is not the best device for improving cycle efficiency or liquid subcooling. The triple pipe exchanger must be installed in a horizontal line with the liquid connections pointing downward. Installing it in any other position will seriously impair its effectiveness for cleaning up slopover. These units must be installed so that the suction outlet drains the shell, to prevent oil trapping.

The triple pipe exchanger, Fig. 21, is more suitable for cleaning up slopover. However, it is not the best device for improving cycle efficiency or liquid subcooling. The triple pipe exchanger must be installed in a horizontal line with the liquid connections pointing downward. Installing it in any other position will seriously impair its effectiveness for cleaning up slopover.

Excessive superheating of suction gas must be avoided with any of these heat exchangers. It will cause excessive discharge temperatures, especially in Refrigerant 22 systems. It is good practice to provide a valved liquid by-pass around the liquid-suction heat exchanger, particularly in Refrigerant 22 systems, so that adjustments can be made if overheating of the compressor is apparent.

Shown in Fig. 22 is a liquid-suction heat exchanger used to clean up slopover. This problem is characteristic of flooded and semi-flooded evaporators such as cold diffusers with prime surface coils; flooded water chillers; dry expansion water chillers.

Oil return to the compressor from these evaporators must be accomplished by either bleeding or flooding some of the oil-rich liquid into the suction line. This oil-rich liquid must be rectified. The usual means is by use of a liquid-suction heat exchanger. It evaporates the refrigerant from the mixture and permits only the oil to be returned in liquid form, by entrainment or gravity to the compressor. The recommended location for the exchanger for this purpose is near the evaporator in a horizontal run.

Fig. 22 shows a prime surface coil-type cold diffuser, fed at the bottom by a thermostatic expansion valve. It is necessary to flood liquid out the top of this coil to return oil. Note the location of the liquid-suction heat exchanger used for rectifying this liquid slopover.

In Fig. 23 is shown a flooded water cooler which incorporates an oil-rich liquid bleed into the suction line for returning oil. The liquid-suction heat exchanger serves the purpose of boiling the liquid refrigerant out of the mixture in the suction line.

Fig. 24 is a cutaway view of a typical oil separator. The purpose of an oil separator in the discharge line is to minimize the quantity of lubricating oil in circulation through the system and keep it in the compressor where it belongs. Oil separators are not 100 percent effective, however, and will not correct poor oil return caused by inherent oil traps or improper line sizing.

In general refrigerant systems operating at high levels of suction temperature are better off without oil separators, providing they are properly designed for oil return at all loadings.

The condensation of liquid refrigerant in discharge line oil sep-

Continued on page 32

By HORACE W. WILSON,
President
Quaker City Cold Storage Co.
Philadelphia, Pa.

Is Automation Feasible In Refrigerated Public Warehouses

This is a condensation of the address given by Mr. Wilson at the Canadian Warehousemen's Association Convention. He claims no practical experience with automation, however, he has made extensive studies and investigations of the problem and in this paper presents the warehouseman's viewpoint. In a direct answer to the question "Is automation feasible?" he states "I think so, in certain cases."

»» Customers' requirements of refrigerated warehouses in the metropolitan areas have changed materially from that of storage to distribution. Where we used to handle possibly thirty major commodities in large lots and store them for long periods, we're now handling hundreds and in very small lots and for fairly prompt delivery. With the growth of the chain stores and the competition this has brought on, producers and processors have been forced to reduce their prices and this, in many cases, has necessitated the building of warehouses at the points of origin. The chains themselves have also built new warehouses, and, have built to meet present-day needs in the hope that they, too, can operate more cheaply. So, the question uppermost in our minds is: Can we stay in business unless we reduce our costs; can this be done with automation; is it feasible; and, can we afford it?

With the ever-increasing spiral of wages, I feel we must, if we're to stay in the public storage (or maybe I should say distribution) business, find some way of reducing our costs. Properly designed warehouses with automation where practicable, if not too costly, may be the answer.

We belive multi-story buildings, but probably not over four-stories high, with elevators on the outside of the buildings and with wide receiving and delivery platforms, can be used to advantage. Where rollers and belts are employed, racks seem to be a necessity. We feel part of the building should be so equipped, but open space should be reserved for bulk handling. Incidentally, multi-story warehouses apparently present no problem in automated operations and the publicized inefficiencies of multi-story buildings can be overcome by modern equipment.

There have been a number of installations of automatic conveyors in multi-story warehouses; these units convey the complete pallet load or warehouse truckload so that fork truck operators can remain on their respective floors and operators' time is not lost waiting for and riding conventional elevators.

In this connection, I quote from a well-known authority: "As to the future, it is possible that changing trends or revolutionary developments will completely alter our concept of a warehouse and distribution center. However, assuming there are no revolutionary changes, it appears likely that we shall see more and more plant and equipment per employee with resultant increases in output per manhour. It is logical to visualize the warehouse of the distant future as either a large, single-story plant or a very special multi-story building. Perhaps we shall see a return to the urban locations in newer type, large floor space multi-story plants, in which each floor shall be a single-story plant in itself complete with all facilities. It's conceivable that cars, trailers and trucks will eventually be equipped with self-unloaders or will carry cargo containers which would discharge cargoes on conveyor aprons and thus move into and throughout the warehouse."

Automatic operation uses many devices almost unknown to the average warehouseman. To mention a few, there are computers; electric interlocks; photoelectric cells; code identifiers and counters; solenoid actuated escapements; photoelectric relays and decoders; limit switches; magnetic drums, etc.

Impulses can be by manual operation of electrical contacts by punched cards, by punched tape, or by magnetic tape.

You Need High Volume

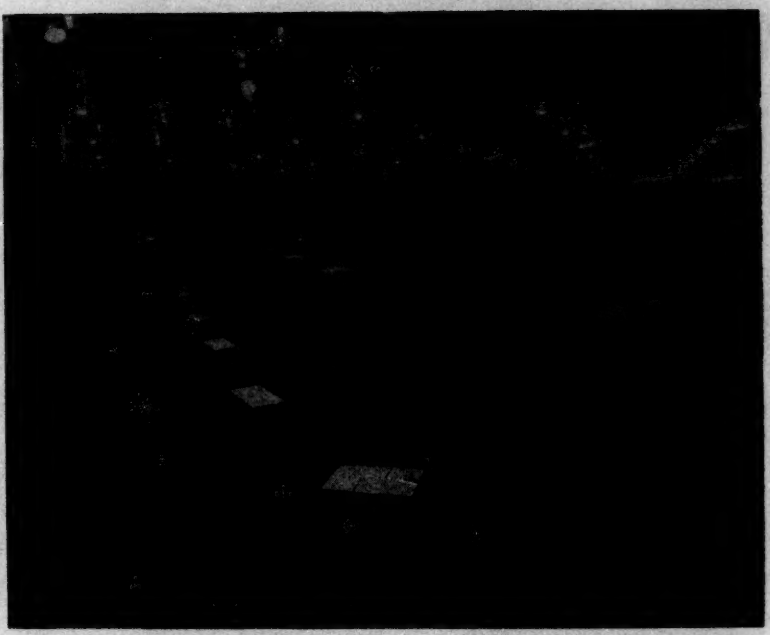
In most cases, it has been proven that there must be a high volume of movement to justify the automation of a warehouse. The equipment is quite expensive and there must be a definite flow pattern in order to design equipment to accomplish and give the flexibility necessary to provide efficient low cost handling; generally fast moving items lend themselves more readily to automation. One-floor plans are usually most suit-

able and most efficient and will be less expensive as far as initial cost is concerned.

Two recent installations of automatic systems handling pallet loads on both vertical and horizontal conveyors, including pallet loaders, conveyors, and automatic electrical interlocks, cost approximately $1,000,000 each. One was for a sugar concern and one for a food processor, but I don't know how much equipment was involved.

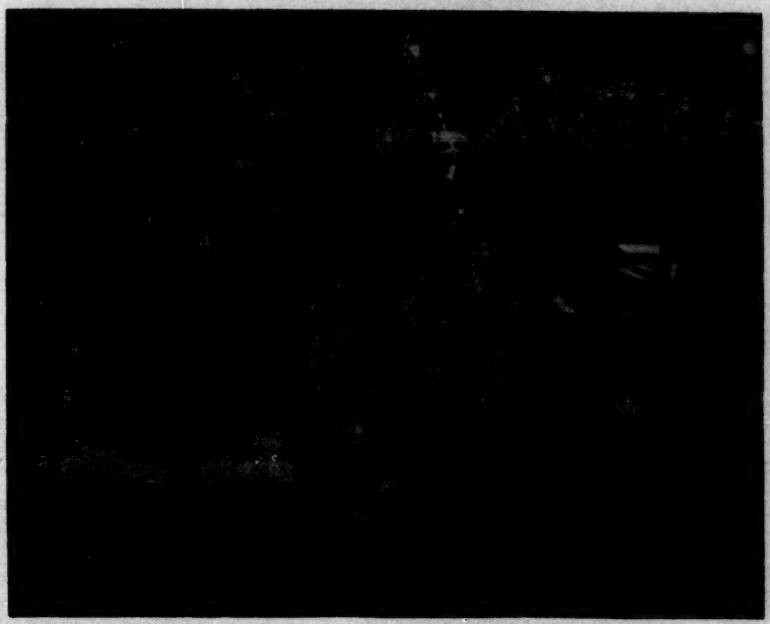
One manufacturer advises they normally figure approximately $1,200 to $1,500 per storage line, which includes controls and the collecting-belt system at the discharge end of the storage line. This figure does not include any storage system that might be necessary to collect and hold orders prior to truck or rail shipment, but they neglected to advise how much the storage line would accommodate.

One of the systems presently in use in a processor's food warehouse uses gravity type roller-conveyor storage lines sloping about ½" per foot towards their discharge ends; solenoid actuated escapements control the flow of products to transverse belts that converge in a single chain-driven live roller discharge conveyor. At the end, individual products may be palletized and moved to delivery trucks. Operation of the system is controlled by an electro-mechanical computor, actuated by push-buttons and switches on a special console. To set up an order, the operator throws case count switches for the quantity ordered; then sets the commodity selector switch for the appropriate item. The theoretical output of this system, based on one large order, is 7,200 cases per hour. Theoretical minimum based on one-case orders, is 240 cases per hour. Orders at this plant average eight cases each, which enables the handling of 1,200 cases per hour or approximately 10,000 per eight-hour day. This installation comprises 69 conveyor storage lines arranged three tiers high, most of the lines being 100 feet in length; this provides a total of 5,500 feet of mobile storage space sufficient to store 4,400 cases. Floor area re-



This picture shows how cartons from 120 automatic flow lines are discharged onto four automatic belt conveyors in an automated distribution center kept at sub-zero temperature at Jerseymaid Milk Products Co. Los Angeles.

Conveyors successively or progressively converge into one line, as illustrated here, prior to feeding merchandise onto one of two reciprocating gravity surge conveyors in Jerseymaid's distribution center. Flow is regulated by two I.B.M. card readers and a controls panel.



quired is 5,500 square feet. By extending short lines and adding an identical system above the present one-storage, capacity could be increased to 15,000 feet. Each of the three tiers of conveyors discharges to its individual transverse belt. The console contains a vertical bank of quantity selector switches numbered from 1 to 9, and in addition, there is a switch for 10 and one for 20. By combining the digits with the 10 or 20 switches, a case count of from 1 to 29 may be set up in the circuit.

Can You Save Money

As to direct savings, let's consider an example: If an average man can fill orders at a normal rate of 150 cases per hour, using motorized tractor and trailer, it would result in an average picking cost of 6¢ per case. This figure includes equipment depreciation, supervision and other overhead expenses.

A system such as described would pay off in about six years if an average of 18 cases per storage line are shipped each day, or four years if the average is 24 cases. This curve makes allowance for manual loading of the system's conveyors, manual stacking into trucks, equipment write-off (with 6-8% profit on investment), maintenance, supervision, and other overhead expenses. Figures will vary with different warehouse operations but the curve will still give an indication as to the advisability of investing in such a system.

Cost Per Case

At an average 25 cases per line per day, a 3½¢ per case handling cost can be anticipated. This is based on a 10-year depreciation period and includes all operating and other expenses.

The curve indicates that if a warehouse presently operates at a cost of 6¢ per case, then the mechanical handling of commodities, each ordered out at an average of 10 cases per day, would safely retire the required investment.

Further study usually reveals that the investment for handling all items shipped in quantities of five or more per day can be justified. The slower movers can be handled on short storage lines and operate with control equipment and collecting conveyors already justified by the major portion of the system.

In another system, packages may be received as individual units or in large lots. In the first case, the packages usually arrive in single file on a conveyor line. Large lots are usually received on pallets or in cubes. The problem of automatic warehousing at this stage is determined by the intended technique of storage. If packages are to be stored as units on live conveyor lines, the individually received ones can be directed both to storage conveyor lines and bulk storage areas. Packages that have been received on pallets and must be separated can be handled by automatic pallet unloaders which dismantle the loads and place the individual packages in single file on conveyor lines. If the packages are received in pallet loads and are to be stored this way, they can be directed to live conveyor lines capable of handling pallet loads. Loaders are available that can palletize items from several production lines.

Automatic equipment presently in use can accumulate as many as 600 cases at a time, and this permits the simultaneous loading of two or more trucks. During the loading, medium belts regulate the flow to overhead conveyor belts and a photocell counting mechanism prints the number of cases per each order. Photoelectric cells actuate the automatic counter. Commodity orders ranging from one to several hundred of cases in a wide variety of more than 350 items of stock can be combined and conveyed in proper route delivery sequence to waiting refrigerated trucks.

I think automation is feasible; that is, it's capable of being done in public warehouses, but I don't think we dare adopt it unless we can get term contracts assuring the almost continuous daily use of the equipment during its write-off period. We can probably profitably install parts of the system such as racks, rollers, belts, etc. We'll undoubtedly have to have something to augment the elevator and the forklift truck.

Potatoes Need Controlled Storage Temperature

»»» POTATOES have a strange knack of turning sweet when stored at low temperatures. For this reason controlled temperature means everything to their eventual usefulness, according to R. B. Hyde of the Canada Department of Agriculture's Experimental Farm at Morden, Man.

At temperatures below 50 degrees F the starches in stored potatoes begin to turn into sugar, the change becoming more rapid as freezing point is neared.

The sugar content of standard varieties of potatoes stored for one month at 40 degrees was found to be five times the amount measured at harvesting. In subsequent months it did not increase much and most of the sugar that accumulated during storage disappeared after the potatoes had been kept at room temperature for two weeks.

Other points brought out in the study were: Potatoes chilled below 40 degrees retained their sweetness. Household storage at 40-42 degrees checked sprouting considerably.

Storage temperatures above 45 degrees are necessary for potatoes that are to be processed into chips and french fries. (Such potatoes can be conditioned at higher temperatures just before being used for manufacture.)

Mr. Hyde adds that the sugar content of potatoes may go up in storage to as much as 10 percent of the tuber's dry weight, and the lower the specific gravity of the tuber the quicker is the rate of sugar accumulation, generally speaking.

Potatoes stored at low temperatures, he concludes, develop a sweet taste, have poor appearance when cooked for the table and produce dark colored chips and french fries.

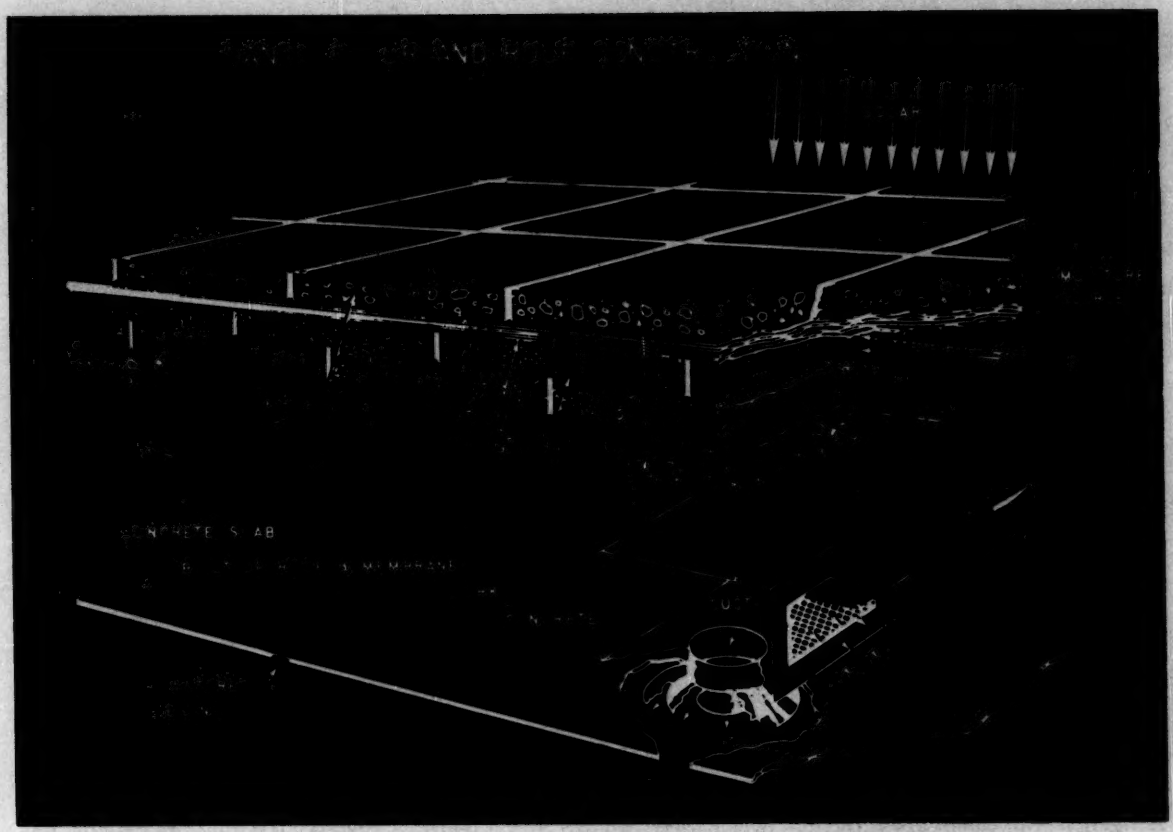


Fig. 1—Structure of roof and ceiling showing location of air ducts.

A Case History

What Condensation Can Do In A Refrigerated Structure

By WALTER E. ELLIS
Ellis and Watts Products, Inc.

»» CONDENSATION within refrigerated structures can become a realistic and serious problem. As an example: The cold storage house at Wiedemann Breweries at Newport, Kentucky, has a dance pavillion on the roof. The space beneath the dance pavillion is the store house for the brewery, maintaining 45° and up to 80% relative humidity. The floor construction of the dance pavillion consists of a 3-inch concrete slab divided into modular blocks. (See Fig. 1)

Directly beneath the concrete slab is the built-up roof made up of tarred membrane and felts. The roof drains and scuppers are located at various points in the roof. Directly beneath the roof membrane is 6 inches of cork supported by 4 inches of poured concrete with the necessary structural members within the composite structure for strength. About 24 inches beneath the poured ceiling slab is a suspended plastered ceiling. The distribution ducts, to maintain the 45° temperature within the store house, are located between the suspended plastered ceiling and the building structure.

Two years after the building was completed, we were called in as consultants by the building contractor because quantities of water were coming through the poured slab and collecting above the plastered ceiling, seriously impairing the structure of the ceiling. The building contractor was being blamed for installing a roof that was punctured or at least not water tight. It was to be his responsibility to remove the dance floor (concrete

slabs) to get to the roof itself and then if a leak were found in the roof, to inspect the cork below and replace if damaged. This represented many, many dollars to the building contractor and it was his opinion that the roof, because of its physical makeup, was a self-sealing roof.

It was decided by the owner, general contractor, engineers, and architects to flood the roof, maintain the flooded conditions for a specific number of days, and if the volume of water that came into the store house increased, it would be definitely concluded that the roof leaked and that it was to be the contractor's responsibility to replace the roof and any water-soaked cork. This flooding was done and although the water dripping from the ceiling increased, it did not nearly approach the volume that the technical minds thought it would. At this point in the experimentations the contractor brought his problem to our company. We came to the conclusion that this was a condensation problem from within the structure and upon investigation we came upon these facts:

Condensation On The Ducts

The first indication that problems were present, was condensation occurring on the outside of the supply ducts in the space between the suspended ceiling and the building structure. The engineers had not insulated the supply ducts. As a result the apparent simple and expedient way to prevent the condensation on the supply ducts was to cut numerous holes in the ducts allowing cooled air to be dumped into the space between the plastered ceiling and the building structure. The air in the supply ducts is cool and has a higher relative humidity when compared to the warmer air returning to the cooling coil. Therefore, although the holes in the ducts eliminated condensation on the outside of the ducts, it eventually aggravated the whole condensation problem in that the temperature between the plastered ceiling and roof was now lowered about 10–15° and the relative humidity correspondingly increased. This presented a moisture source from the cold side.

The dance pavillion was certainly a good thought from the architect's and owner's standpoint, but since a 3-inch slab of concrete was exposed to the elements, and also almost daily washed down, and the built-up roof was 3 inches beneath the top of the concrete slab, the roof decking and membranes were never in a dried condition and provided a moisture source on top of the roof. The roof itself, at some time, must have come up in temperature to the flowing point of the tars since it was an established fact that the scupper drains had tar in them in sufficient quantity to have required cleaning. This flowing of the tar seemed to eliminate the possibility of the physical roof leak, since it was reasoned that, even if a workman had inadvertently fractured one or all plys, there should have been ample pitch between the plys to self-seal the fracture. Therefore, the leakage must have been due to an internal condensation problem.

Upon investigation it was established that the main steel structure consisted of longitudinal beams which were exposed to the underside of the roof into the 45° temperature space. Around these beams covering approximately 75% of the beam was poured concrete. The cross supporting members extended 4 inches into the cork. Therefore there was only 2 inches of cork between the bottom of the roof membrane and the cross steel members of the building structure. The building structure was riveted and welded, therefore two actions were taking place.

First there was transorption of moisture flow from a high absolute moisture level to one of low absolute moisture level. This action of transorption could go in both directions depending on whether the inside space (between the plastered ceiling and the concrete roof) was a higher absolute moisture content than the actual ambient outdoor conditions, which it would be in the wintertime, and consequently flow would be from the store room to the outdoors. In the summertime the reverse would be true whereby the outdoor ambient absolute moisture would be higher than the store room absolute moisture and transorption would occur from outside to inside.

The second problem was the temperature gradient across the insulation and providing there were no materials with body temperatures below the dew point, moisture vapor would not condense. However, due to the physical structure, the cross beams were within 2 inches of the roof membrane and the 45° temperature was transmitted through the steel work and provided a condensation point within the insulation. Since the transorption was taking place, a moisture vapor source was present and water condensed on the beam that was imbedded in the cork. The cork would wet, its insulation value would drop and the process would be repeated at a faster rate, wetting the cork and this progression pyramided. Cork is a hygroscopic material and will absorb, hygroscopically, some water.

In time the cork became saturated and the process produced liquid water. The water then channeled down the beams through the cork and appeared as liquid water coming out the poured concrete ceiling and dropped upon the plastered ceiling. When the roof deck was flooded, liquid water was not leaking through the roof deck but the roof deck now passed additional water vapor by transorption since the vapor pressure above the deck was higher than the vapor pressure within the room. Consequently since only the vapor rate was increased, due to greater pressure differential, the liquid water flow increased when the deck was flooded but not to any great extent.

The problem was not solved by knowing the reasons for the condensation. However, we watched with interest when the roof was pulled off. Our predictions were proven right when the cork was examined. The final solution to this problem was the installation of fiber glass insulation which greatly reduced the transorption and the removal of the suspended ceiling which helped one of the moisture sources.

In no way are we implying that the use of cork or similar insulation should be discouraged, but the basic problem occurred when the architect did not realize the problem that could result from steel structure within the body of the insulation.

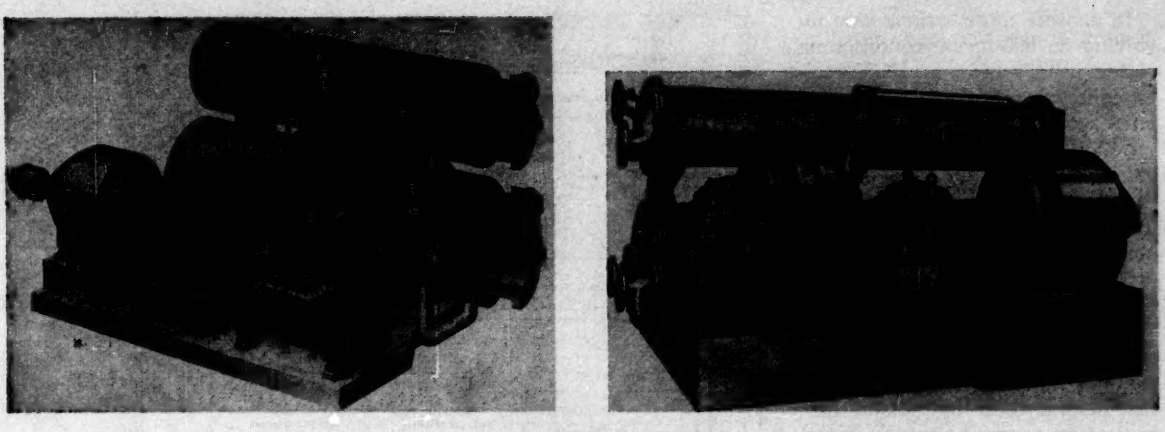


Fig 1 shows two widely used package-type centrifugal refrigerating units.

Prevent Freeze-ups of Water Chillers

From Mutual Boiler and Machinery Insurance Co.

»» AN increasing number of refrigerating systems of the centrifugal packaged type are being employed for air conditioning and industrial process temperature control. Two units of this type are shown in Fig. 1. This equipment may be expected to give efficient and dependable service if properly maintained and protected. As with any kind of machinery, however, there are certain hazards to be guarded against in operation. The most important of these, on the basis of Mutual Boiler's experience, is the danger of freeze-up of the water in the chilling coils or cooler.

In one case the double serpentine copper coils in a 150-gal. chiller connected to a 30-hp refrigerating system ruptured due to freezing when the controls failed to maintain a minimum water temperature of 38°F. This resulted in the flooding of the entire system and necessitated a complete dismantling of the system to dry it out and replace damaged parts. A diagrammatic sketch of the system is shown in Fig. 2. The coils were surrounded by refrigerant, and the water was circulated through the coils by a small centrifugal pump.

Under normal operating conditions the thermostat kept the water temperature at 38°F. If the water temperature dropped to 36°F, a solenoid dump valve would open to release water from the storage space and admit city water until the temperature was raised to 38° F, at which point the dump valve would close. In the event that the dump valve failed to function, the pressure-regulating valve would take over and control the flow of refrigerant to the cooler to prevent the water temperature from falling below 35°F.

The refrigerant entered the chilling chamber through a perforated tube and, when the freeze-up ruptured the copper coils, the refrigerant chamber was filled with water under the city-main pressure of 70 psi, which was sufficient to force water into the refrigerating system.

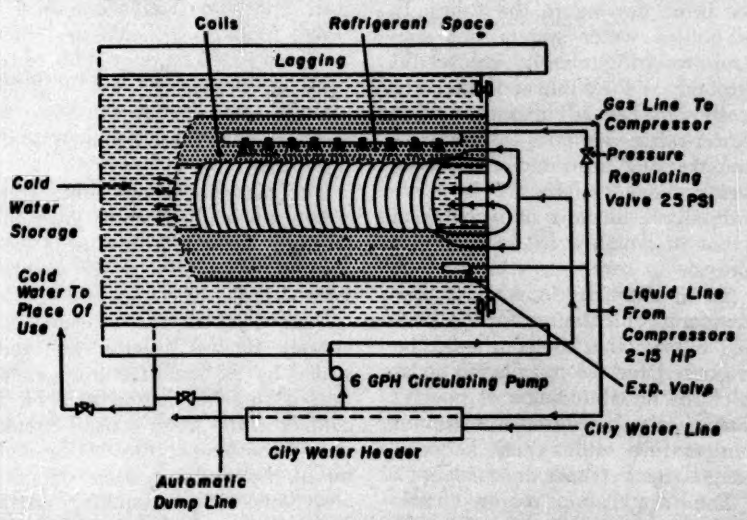


Fig. 2. Diagrammatic sketch of a 30-hp refrigerating system. When controls failed to maintain a minimum water temperature of 38° F, water froze in the double serpentine copper coils in the 150-gallon chiller. The chills ruptured and the entire system was flooded.

In another more serious case involving an 800-hp air-conditioning system using refrigerant 12, 33 cooler coils ruptured due to freezing and caused a property damage and production loss totalling $84,000. In this case the accident was caused by the failure of the water low-temperature cut-out. Again the system had to be dismantled for drying and for the replacement of damaged parts.

In the two cases cited it is not definitely known why the safety controls failed to function as intended, but these and other similar accidents emphasize the need for periodic maintenance and testing of these vital safety devices.

Safety Controls

A typical electrical control diagram is shown in Fig. 3. These units are usually equipped by the manufacturer with at least three separate and distinct safety controls to guard against freeze-up of the cooler. One of these is the refrigerant low-temperature cut-out with a sensing element located in the cooler near the level of the liquid refrigerant. This temperature cut-out is usually set and sealed by the manufacturer's representative during installation. It functions to open a contact in the series control circuit should the refrigerant in the cooler become cold enough to freeze the water or brine flowing in the tubes. In a chilled water system this control would probably be set at around 34°F. While it is theoretically possible to operate with a lower refrigerant temperature without freezing, restrictions often develop in the tubes or elsewhere to reduce the flow of water to a point at which a freeze-up might occur.

In applications in which a low temperature is desired for the cooling water, the cooler should be oversized for the installation so as to have an abundance of cooling surface, thus requiring a minimum temperature differential between the refrigerant and the coolant.

Some applications require a cooling-system temperature below 32° F. In such installations it is necessary to use brine or a solution of water and one of the glycol base

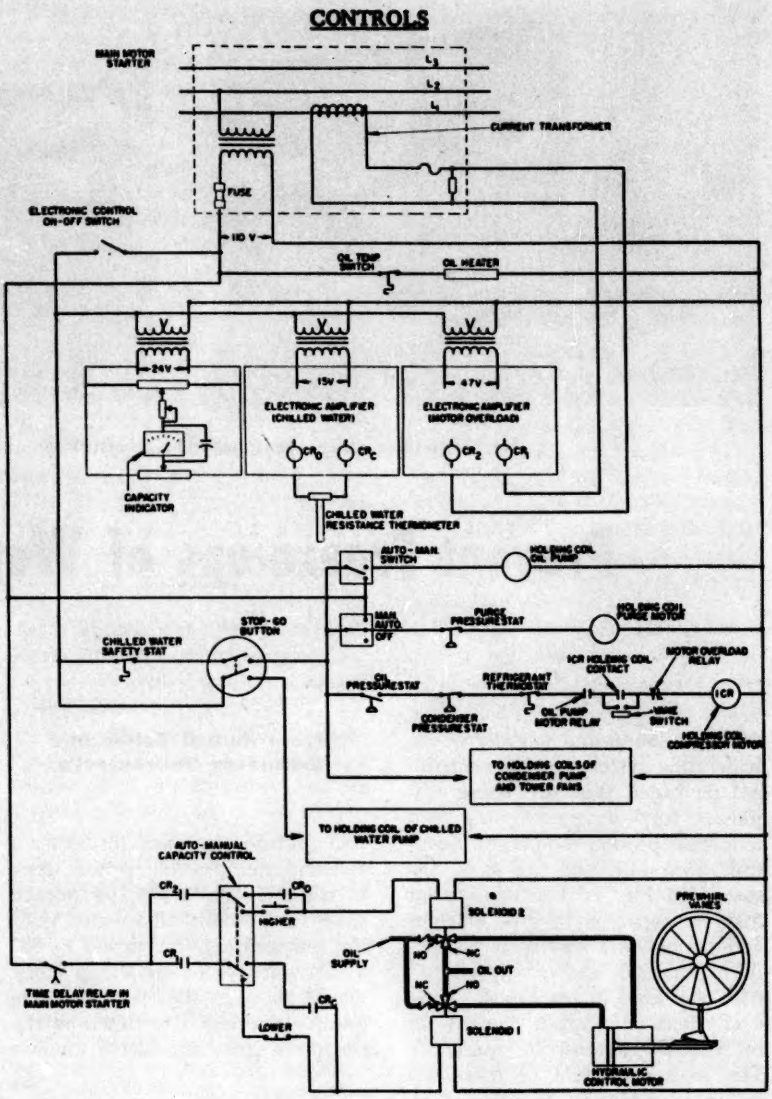


Fig. 3. A typical electrical control diagram.

antifreezes in the circulating cooling system.

The next important safety control is the chilled water low-temperature cut-out. The sensing element for this device is usually located in the discharge end of one of the tubes in the cooler. This cut-out is also usually set and sealed by the manufacturer's engineer during installation to open a contact in the series control circuit should the temperature of the water in the cooler become dangerously low. In a circulating water system this control is normally not set below 38°F. Operators should be instructed not to break the seals of this cut-out or those of the refrigerant low-temperature cut-out, nor to tamper with the adjustment of these devices.

Thermometers are usually provided to indicate the temperature of the liquid refrigerant entering or leaving the cooler. Normally it is a simple matter for the operator to check operation of the temperature cut-outs against these direct-reading thermometers. At a time convenient to plant operating requirements, the refrigerating load on the system can be reduced or possibly the chilled-water flow can be throttled to lower the water temperature. It is then a case of checking the operation of the temperature cut-outs against the ther-

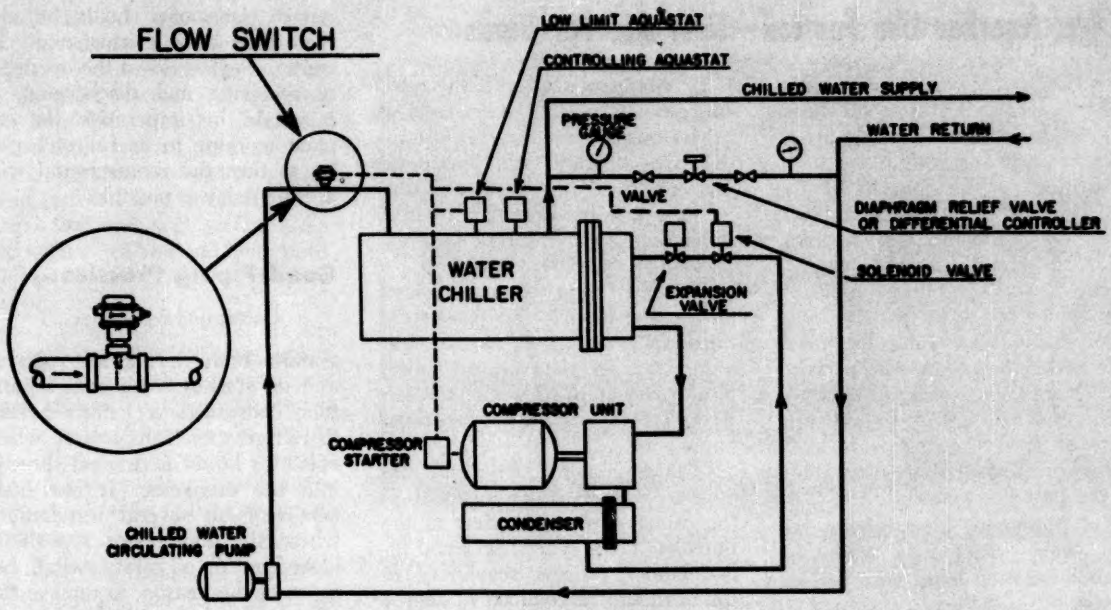


Fig. 4 shows a flow switch and how it can be installed in the water circulating line and connected so as to shut the unit down if the water flow stops or is greatly restricted.

mometer readings. In the case of the refrigerant low-temperature cut-out, it may be necessary to block in the chilled-water low-temperature cut-out to prevent its tripping out ahead of the operation of the refrigerant low-temperature cut-out.

Check Safety Controls

Operation of these two low-temperature cut-outs should be checked and logged by plant operating personnel on a three-month schedule. This might well be done at the same time other maintenance work and control testing is carried out. It is important to check whether the cooler and condenser are operating efficiently. Observations should be made of (1) the difference between inlet temperature and the outlet temperature of the condenser water or brine passing through the tube bundle and (2) the difference between the temperature of the leaving water or brine and the temperature of the refrigerant. In most cases the brine and the condenser water rate of flow are held constant. Under such conditions the temperature change of brine or condenser water is a direct indication of the load . . . the greater the load, the greater will be the temperature differential between the leaving water or condenser cooler "brine" and the refrigerant. The values of these temperature differences at full load should be recorded when the machinery is first operated, and a comparison should be made from time to time thereafter. As coolers or condensers become dirty or scaled on the water or brine sides, the temperature differences between leaving water or brine and refrigerant will increase. An increase of more than two or three degrees above the recorded normal temperature at full load indicates that cleaning of the tubes should be undertaken.

The water-box heads on both the cooler and condenser of these systems are usually made for easy removal to facilitate inspection and cleaning of the tubes or coils without breaking the main pipe joints. The annual maintenance program for refrigerating units should include removal of the water-box heads for inspection and cleaning.

When temperature readings are being taken, it is important to make sure that there is no air in the condenser. The presence of air will greatly reduce condenser efficiency. The purge unit should be in continuous operation for a day before readings are taken. Tube surfaces should be kept as clean as possible; scale and other deposits should be removed at least once a year or more frequently if experience indicates temperature increases. Special attention should be given to the cleaning of tubes containing thermal bulbs or sensing elements in order to assure accurate temperature indications and to reduce the hazard of tube plugging and water freezing.

Interlock Controls

Preferably all circulating pumps for coolers should be electrically interlocked with the starting control. As an alternate suggestion for added protection, a flow switch should be installed in the water-circulating line, so connected as to shut the unit down if the water flow is greatly restricted or stops, as shown in Fig. 4. Continued operation of the circulating-water pump for a short period after a unit is taken out of service is desirable to prevent water left in the cooler from freezing due to the small temperature differential between the refrigerant and the chilled water.

By following the recommendations given above, operators can greatly minimize the hazard of freeze-up of water chillers.

Another Use For Ice—First Aid For Burns

»» ICE water was recommended recently as the best first aid measure for any burn covering up to 20 percent of the body.

Writing in the Journal of the American Medical Association, Dr. Alex G. Shulman, Los Angeles, said, "My experience indicates that, whatever the subsequent management may be, those patients who receive initial ice-water treatment fare better than those who do not."

Although the beneficial effect of cold in burns has been sporadically advocated for many years, he said, it has been studied seriously only in the past five years.

Dr. Shulman's investigation began eight years ago when he burned his own hand with boiling grease.

"In the ensuing agonizing few minutes it seemed logical to plunge the hand into a tub of cold water," he explained.

Finding that the pain was alleviated and the burn subsequently healed more rapidly than expected, he decided to use the same therapy for his patients.

His method is to place the burned area immediately into a basin containing tap water, ice cubes, and the disinfectant hexachlorophene. For burns of the head, neck, shoulder, chest, abdominal wall or back, where immersion is impractical, he applies towels chilled in a bucket of ice water.

The cold treatment is continued until it can be stopped without return of pain. The period ranges from 30 minutes to five hours.

Dr. Shulman said he had treated 150 patients in this manner. Most of the burns were thermal, due to excessive heat or cold, but some were chemical and electrical burns.

"In every patient thus treated, immediate gratifying relief was expressed at once," he said.

"Whereas pain ordinarily lasts 24 hours or more in the first degree burn, relief in these patients was immediate, and the pain was almost totally absent by the time the patient left the office two or three hours later.

"The impression obtained from our experience is that, although the primary injurious effect of the burn has taken place, the usual inflammatory process secondary to the burn can be reduced in degree and, indeed, at times reversed by ice-water therapy.

"No infections have been encountered in those patients treated within one hour of injury.

"The time factor between injury and treatment determines the result. This treatment should, therefore, be initiated if possibly by the patient or first-aid attendant at once. This would be far more effective first-aid treatment than the usual first-aid measure of applying butter or grease which will only have to be painfully removed later by the attending physician.

"It is suggested that this humane and simple form of first-aid management of less extensive burns should find its way into the thousands of books, manuals, and pamphlets on first-aid throughout our nation."

Quick Freezing Cartoned Beef

Continued from page 13

was 141,282 killowatts, which works out to .065 killowatts per lb.

The justification of the expense of installing the quick freeze tunnels is supported by the saving in labor, time and space. Holding rooms have many times the capacity, and there is a guarantee that the meat is hard frozen and in good keeping condition.

In summarizing, there are quite a few points to bear in mind for the successful operation of quick freeze rooms.

It is of prime importance to choose a site within easy reach of stacking rooms, and so keep labor and mechanical costs to a minimum. The chambers should be reasonably small to obviate excessively heavy equipment and to allow a quick turnover. They should be constructed so as to be readily adaptable to receive any type of product whether it be cartoned meat, quarter-beef or any form of package.

Planning the traffic flow in and out of the rooms should be such that there is no confusion or disruption to slow down the operation of receiving and discharging, as it would be imperative for any plant working to its fullest capacity to turn the rooms round with as little delay as possible.

Good Piping Practice

Continued from page 23

arators, both during idle periods and on start-up with cold separators, constitutes a serious hazard to refrigeration compressors wherever this liquid is drained directly into the crankcase. It has been necessary on several installations where the compressor repeatedly kicked out on oil safety switch, because of this reason, to remove the oil separator before the trouble was cured. This has only been done where the system was properly checked-out to make sure oil would be achieved at all loadings.

Where to Use Them

For some applications, oil separators have certain advantages, although the hazard of their use is still present.

One such application is in systems using evaporators that require continuous refrigerant slopover or bleed into the suction line for adequate oil removal. Cold diffusers with prime surface coils, as well as dry expansion and flooded water chillers fall into this category. Since the oil separator will remove a substantial portion of the oil in the hot gas discharge line, the use of one makes it possible to reduce the amount of bleed off or flood through necessary and still return the smaller amount of oil in circulation back to the compressor.

Another application is in high tonnage systems employing capacity reduction. Here, the oil separator greatly reduces the amount of oil in circulation. It will still be necessary to design the system for oil return to cover the possibility of long periods of operation at the lowest compressor displacement. The use of the separator merely reduces the hazard of the compressor losing its oil at periods of low loading.

Still another application is in low and ultra-low temperature systems. At low temperatures, oil becomes more viscous and therefore it is important that the circulation of oil in the system, particularly in the evaporator, be kept to a minimum. Oil on the surfaces of the evaporator coils will act as insulation which will reduce heat transfer and therefore reduce evaporator efficiency.

Fig. 25 shows a typical oil separator installation. Where separators must be used, certain precautions should be taken to prevent liquid accumulation in the separator during the compressor off cycle, so that liquid refrigerant will not be returned directly to the compressor crankcase:

1. Install the separator ahead of the hot gas line loop, as shown in Fig. 25.
2. Insulate the separator to minimize its capacity as a condenser.
3. Whenever the condenser is subject to higher temperatures than the compressor during the off cycle, install a check valve in the hot gas line near the condenser.

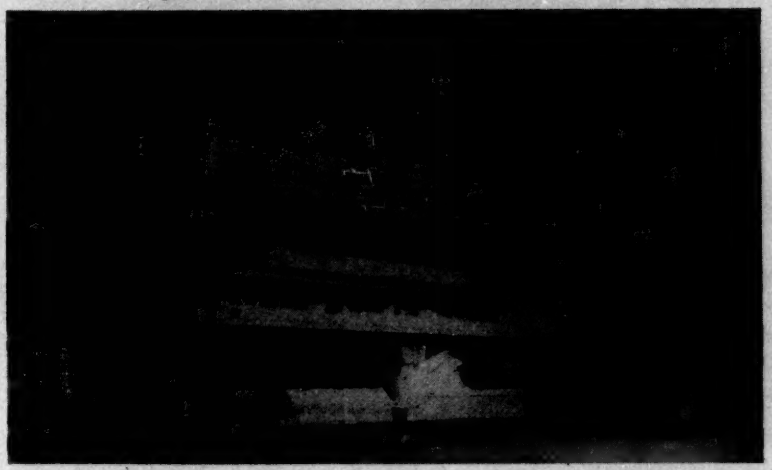
"Freon-13" Available Through Wholesalers

»» THE availability of "Freon-13" refrigerant through established wholesaler distribution channels and a substantial reduction in the price of this low-temperature refrigerant to original equipment manufacturers have been announced by Du Pont's "Freon" Products Division.

Du Pont's wholesalers number more than 700 and are scattered strategically throughout the country. Under the new distribution system, cylinders of "Freon-13" will be available from them, rather than handled as a development product through a limited number of Du Pont warehouses.

Beginning September 26, Du Pont will sell "Freon-13" directly only to wholesalers and to manufacturers of refrigeration equipment. Du Pont will absorb the added cost of distribution, so that the ultimate price to contractors, service firms and industrial consumers will remain virtually unchanged.

Two Compartment, Multi-Temp Trailers Developed



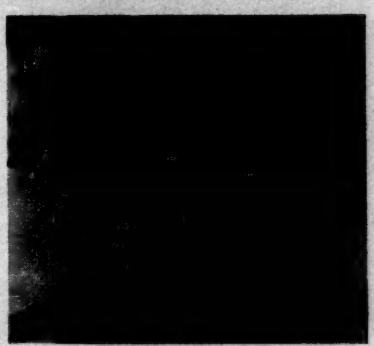
New, specially designed two-compartment, multi-temperature refrigerated trailer developed for Red Owl by Great Dane Trailers, Inc. and Thermo King Corporation for carrying mixed loads of perishables.

»» TO MEET the demands of transporting supermarket perishables, A. Peter Fitch, Red Owl garage superintendent, needed a trailer that could haul vegetables as well as frozen foods. Current models of refrigerated trailers could haul frozen foods or fresh produce but not at the same time as both commodities required different temperatures.

Needed was a two-compartment trailer with side doors and a refrigeration system that would offer cooling in both compartments at different temperature levels. The problem was solved by engineers of Great Dane Trailers of Savannah, Georgia, and the Thermo King Corporation of Minneapolis, Minnesota.

Great Dane developed a trailer with two side doors and a sliding bulkhead door inside the trailer. Thermo King designed a refrigeration unit for the front compartment that would provide sub-zero temperatures for frozen foods and ice cream. This unit also was designed to provide power for a second unit in the rear compartment. In addition this unit provided for low temperature cooling for fresh produce in warm weather and heat for fresh produce in winter.

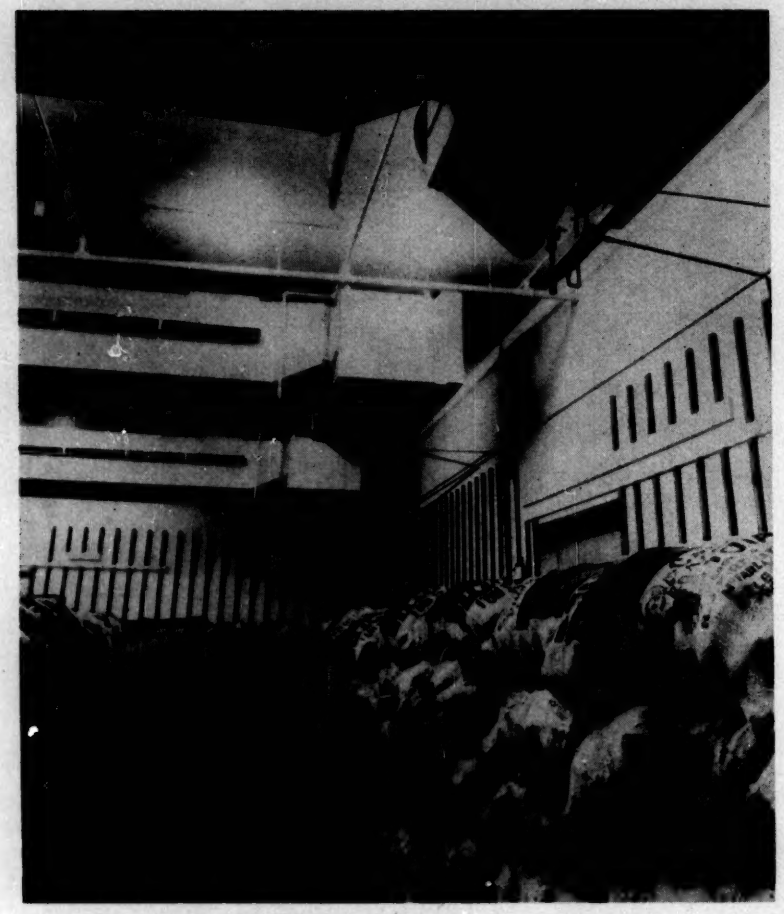
The specially designed rig is ideal for the mixed loads of frozen and fresh produce as supplied to Red Owl Stores from the main warehouse. It is extremely versatile as it provides the following selection of operating conditions:



A. Peter Fitch, garage superintendent for Red Owl, demonstrates the sliding bulkhead door between compartments. Sliding feature enables the operator to vary size of the front compartment or rear compartment depending on the type of cargo. The door folds to the ceiling when not in use.

1. Both front and rear compartments at the same time: front for low temperature, rear for high temperature cooling or heating.
2. Front compartment only, low or high temperature.
3. With bulkhead door removed, high temperature cooling with both Thermo King units operating. Also, high temp cooling with just front unit and low temp cooling with front unit only.
4. Using rear compartment if heat is required for the load.

Modern Refrigerated Produce Warehouse



Section of United Growers, Inc. Warehouse at Portland, Ore., where every kind of produce from potatoes to bananas can be handled.

»» THE new $500,000 warehouse of United Grocers at Portland, Oregon is one of the most extensive applications of refrigeration to fresh fruit and produce handling in the United States. 175 tons of refrigeration were installed in the warehouse by Temp-Control Corporation of Portland. It accommodates anything from potatoes to bananas.

The 51,000 square foot warehouse, believed to be the most modern for produce handling in the U.S. and Canada, contains such innovations as automatic doors, as separate spur for refrigerated cars, and automatic platform lifts for trucks. It permits the company, which serves 700 dealers in Oregon and Washington, to ship combined or straight loads of fresh fruit and vegetables, according to Keith Kruchek, consulting engineer.

Incoming produce can be immediately placed in one of two large coolers, 40 x 150 ft., and 80 x 105 ft.

Eight separate banana ripening rooms as well as temperature and humidity controlled rooms for repacking tomatoes, avocados and bananas are available. Prepacking rooms can be kept at constant temperatures.

Seventeen Recold product coolers with centrifugal blowers are used for air handling and temperature control.

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5. Size of each compartment may be varied as required with the sliding bulkhead door between compartments.

The specially designed trailer is 38 feet long and insulated with 4" of insulation. It has one side door near the front of the trailer and another side door midway. These doors are essential for entry into either compartment for loading, unloading and peddle-run operations.

Red Owl has purchased 61 of these units which they are currently operating.

Heat Transfer Conference Next Year

»» THE frigid air of the cold war should melt appreciably as heat transfer scientists the world over, including sizable numbers from Russia and red-satellite nations, begin to draft final plans and scientific papers for the Second International Heat Transfer Conference to be held in Boulder, Colorado, late next year.

The purpose of the conference is to bring together leaders in heat transfer research and application for free scientific inquiry and discussion of important new work in the field. The last such conference was held in London in 1951.

According to the conference secretary, Dr. S. P. Kezios, professor of mechanical engineering at Illinois Institute of Technology, the response to invitations to participate in the conference has been overwhelming. "More than 300 manuscripts outlining advances in the field of heat transfer technology have already been submitted to me for consideration as discussion topics at the conference," Kezios stated.

Kesios, of 3100 Michigan ave., Chicago, recently returned from Europe where he met with representative of the Institution of Mechanical Engineers and the Institution of Chemical Engineers of Great Britain, co-sponsors with the American Society of Mechanical Engineers in the 1961 conference.

Other organizations participating in this Second International Heat Transfer Conference include the American Rocket Society, American Nuclear Society, American Chemical Society, American Society of Mechanical Engineers, and the

Chemical Institute of Canada.

The chairman for the conference is A. C. Mueller of E. I. DuPont de Nemours and Co., Wilmington, Delaware.

NARW Convention Chairman Appointed

››› A. R. CARSTENSEN, president, National Association of Refrigerated Warehouses, announced the appointment of Millard W. Young as chairman of the convention hospitality committee for the association's annual convention to be held in San Francisco March 27-30, 1961. Mr. Young is president of National Ice and Cold Storage Company of California. Mrs. Young will serve as chairman of the ladies entertainment committee.

Mr. Carstensen also announced the formation, for the first time, of a Convention Business Sessions Planning Committee. Members include, besides Mr. Carstensen, Glenn F. Dodson, Santa Clara, California; C. A. Martin, Jr., Nashville, Tennessee; F. D. Newell, Jr., Minneapolis, Minnesota.

Chapters Meet

All seven regional chapters of the National Association of Refrigerated Warehouses have announced plans for meetings during the next six weeks.

Matters of prime concern to their particular geographical area will be included in the program in addition to those problems facing the entire public refrigerated warehousing industry as their services are expanded to meet the increasing needs of the perishable foods industry.

NARW President A. R. Carstensen will appear on each program as the official representative of the national association.

Meetings are scheduled as follows: September 12-13, Great Lakes Chapter, Mackinac, Michigan; September 21-22-23, North Atlantic Chapter, Skytop, Pennsylvania; September 26-27, Southwestern Chapter, Fort Worth, Texas; September 28-29, Southeastern Chapter, Memphis, Tennessee; October 5, Missouri Valley Chapter, Omaha, Nebraska; October 10-11-12, South Pacific Chapter, Monterey, California; October 14-15, North Pacific Chapter, Seattle, Washington.

York Building New Sound Lab

The York Division of Borg-Warner Corporation has announced the start of construction on a second "Sound Laboratory" at its Grantley Road plant in York. The building will be of reinforced concrete, including the roof. Acoustical insulation and acoustically treated doors are designed to keep all outside noises from the "hush" chamber. The present sound laboratory, put into operation early this year, is designed with "hard" walls so that sound will actually bounce back and forth and be amplified. It is expected that the new sound lab will be completed shortly after Thanksgiving.

Frick Company Reorganizes National Marketing Plan Under New Expansion Program

››› FRICK Company, manufacturer of air conditioning and refrigerating equipment, announces the inauguration of a nation-wide regional sales program that will decentralize sales and service responsibility.

Calling the move the "most significant marketing advancement in the Company's 107-year history," Matthew M. Gouger, executive vice president, said that through five newly established regional sales offices, Company support and closer cooperation with branch managers and distributors will be assured.

Coincident with this move a realignment of Frick top sales management was also announced.

David J. Wood, formerly manager of market planning, has been appointed national sales manager. George C. Briley is named manager of field sales and service, David E. Eddy is named manager of technical services, and Warren L. Bain is named manager of sales administration.

Assignments of sales management personnel to regional areas are: John T. Sanders, manager of the Southern Region with headquarters in Houston, Texas; Robert C. Robertson, manager of the Central Region with headquarters in Chicago, Ill.; R. H. Dyson, manager of the Northwestern Region with headquarters at New York; and Allen J. Vandermade, manager of the Western Region with headquarters in Palo Alto, Cal.

Under the reorganized sales program, branches of Frick Company across the country will be supervised by their specific regional managers.

Michigan Built Truck Body First To Pass Scientific Tests

››› A MICHIGAN manufacturer's lightweight insulated truck body is the first carrier to pass exhaustive tests to measure cold-holding properties in accordance with industry-recognized standards.

The tests, conducted by the Budd Company, an authoritative research laboratory, scientifically rate the cold-holding capacity of refrigerated truck bodies.

The independent laboratory reported on the tests of a 14 foot long insulated truck body manufactured by the Haskelite Division of Evans Products Company of Plymouth, Michigan which incorporates design features offering unusually low heat transfer for constant and efficient cold-holding.

AAR Committee Meets At Trane

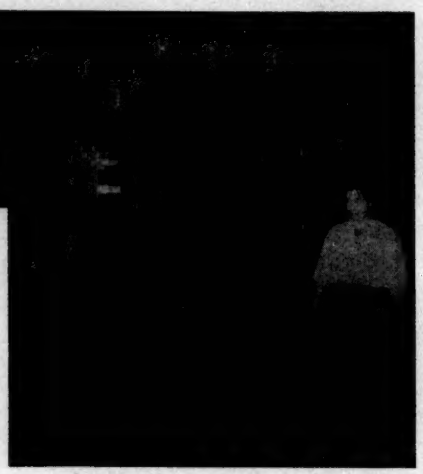
»» MEMBERS of the air conditioning and refrigeration committee, Electrical Section, Association of American Railroads, are shown above discussing a railroad refrigeration unit with J. M. Whalen (foreground), Trane Company transportation manager, while in La Crosse, Wis., for the quarterly meeting of the AAR committee.

Latest developments in refrigeration for the railroad industry were discussed at the meeting held at The Trane Company.

Following the meeting, the committee toured the company's facilities for testing and producing railroad refrigeration equipment. They also watched production of some of the 1000 refrigeration units for cars being built by Pacific Fruit Express Company, and of air conditioning units for 116 new bi-level commuter cars built by The Pullman Company for Chicago and North Western Railway.

Members attending the meeting were, left to right, E. Mohr (foreground), Pacific Fruit Express Company, San Francisco; W. A. Woodworth, Southern Pacific Company, San Francisco, J. L. Christen, The Pullman Company, Chicago; C. C. Elber, AAR, Chicago; R. F. Carter, The Western Pacific Railroad Company, Sacramento; R. H. Russell, Great Northern Railway, St. Paul; R. L. Morris, Louisville & Nashville Railroad Company, Louisville; and J. H. Kucera, Missouri Pacific Railroad Company, St. Louis.

THE ULTIMATE IN THE COMPRESSION REFRIGERATION CYCLE*



THIS IS ANOTHER CYCLE CENTER, factory assembled and on its way to a 150 ton poultry freezing plant.

What will it do?*

It will provide liquid overfeed to the evaporators, catch the excess liquid and recirculate it to the evaporators, with these results:

- FULL COMPRESSOR PROTECTION AGAINST SLUGS
- PEAK COIL AND COMPRESSOR EFFICIENCIES
- SUB COOLED LIQUID FEED AT CONSTANT PRESSURE THE YEAR AROUND
- PRACTICALLY UNLIMITED RATE OF LIQUID FEED AT ABSOLUTELY NO POWER COST
- NO MECHANICAL PUMPS
- NO FLASH GAS IN LIQUID LINES
- SAFE, AUTOMATIC PLANT OPERATION
- OIL SEPARATION, ANY REFRIGERANT
- HIGHER SUCTION PRESSURES
- LARGE POWER SAVINGS
- LARGE SAVINGS IN FIRST COST ON NEW PLANTS. FOR EXAMPLE, THE RECEIVER IS NOT REQUIRED AND SURGE DRUMS ARE ELIMINATED.
- AUTOMATIC HOT GAS DEFROSTING AT MINIMUM COST

ASK FOR BULLETIN CC-2

*** NOT JUST A LIQUID RETURN UNIT.** Available for any refrigerant, in capacities from 10 to 1,000 tons and more. Factory assembly is optional.

J. E. Watkins Co.
307 LAKE STREET, MAYWOOD, ILLINOIS

Lourdes Centrifuge Catalog

»» LOURDES Instrument Corp., a division of Labline, Inc., has announced publication of a completely new and up-dated catalog on centrifuges and homogenizers.

The catalog is a 16-page, fully illustrated book designed to offer finger-tip reference to the complete line. It also lists in detail the rotors and attachments produced for each model.

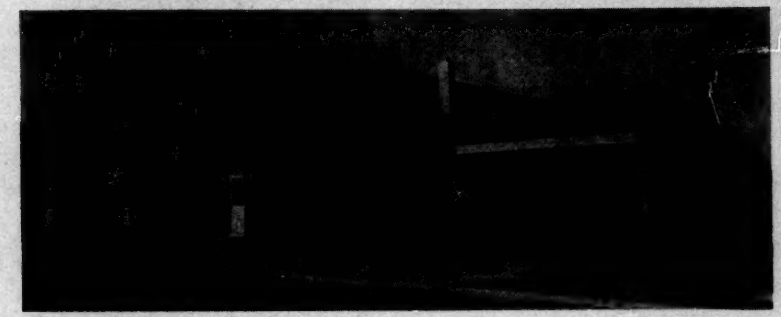
Refrigerated and non-refrigerated models are shown, as well as vacuum and non-vacuum centrifuges. Full details are given on all floor and bench models of both the automatic and non-automatic type.

The new, continuous flow centrifuge system with removable polyethylene liners is also described and illustrated with a schematic drawing and a complete explanation of the method of operation.

Included also are homogenizers along with a large variety of interchangeably usable sealed containers with capacities from 5 ml. to two gallons.

To obtain this new No. 260 catalog, write Lourdes Instrument Corp., 53rd Street and First Avenue, Brooklyn 32, New York.

FES Quadruples Plant Area In Expansion Move



»» EXPANDED facilities for designing and assembling custom-engineered refrigeration packages and FES-Fuller rotary compressors are revealed by Freezing Equipment Sales, Inc. The new facilities are the result of a general expansion program made possible by a recently-completed plant addition which has quadrupled the company's operating space.

Major addition to the plant is a greatly enlarged engineering department. Reflecting an increased demand for custom-engineered service in the refrigeration field, and staffed with professional engineers devoted to the contract execution of compressors and tailor-designed packages, as well as field installation project engineering.

The new two-story building adjoins the original office, in an area formerly occupied by a warehouse. Over-all length of the addition is 102 ft., and it is 63 ft. wide. Construction is of standard building block, finished in the front with brick.

A recently-organized subsidiary of Freezing Equipment Sales, the Fesco Supply Co., Inc., occupies part of the new building. This company operates as a wholesale operation handling repair parts, farm bulk milk tanks, and accessory equipment for industrial installations.

The bulk of the plant addition is given over to a 2,700 sq. ft. assembly floor. This area was planned to meet the increasing demand for large refrigeration packages, both two-stage and three-stage. Full assembly of packages can be made here and shipped out. A 5-ton crane is located over the assembly bay.

A total of more than 8,000 square feet of floor area has been added, bringing actual plant area to nearly 10,000 square feet.

All-Metal Flexible Hose Catalog

»» A NEW 20-page catalog, pictorially describing Universal All-Metal Flexible Hose to convey gases, solids and fluids; for vibration control; and to compensate for motion or misalignment under high temperature, pressure, vacuum or abrasive conditions, has been released by Universal Metal Hose Company.

Detailed descriptions, specifications, and applications-use together with coupling recommendations, are given for conveying gases and fluids like steam, hot oil, gasoline, liquified gases, refrigerants, chemicals, etc., where completely leak-proof hose construction is essential.

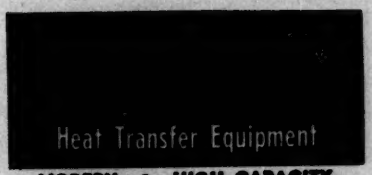
Also included in the new catalog are Universal general purpose industrial hose, ideally suited for tank car unloading service.

Copies of Universal catalog No. ID-100D will be sent, on letterhead request, by writing Universal Metal Hose Company, 2133 South Kedzie Avenue, Chicago 23, Illinois.

New Henry Catalog

»» A NEW illustrated combination condensed catalog and net resale price schedule set up in alphabetical-numerical order to aid Henry Wholesalers render a more complete service to their trade, has been developed by Henry Valve Company.

The new catalog prepared for distribution by the Wholesaler con-



MODERN • HIGH CAPACITY

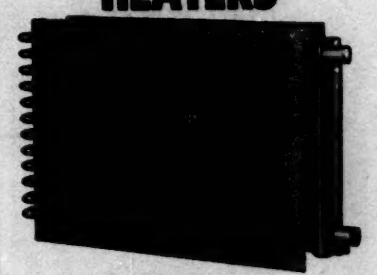
BASEBOARD CONVECTORS

For Residential or Commercial Applications

Distributes heat evenly along cool walls and under windows. Replaces old style radiators—enlarges working space. Only 3" deep and 8" high—comes in 10' lengths. Standard design uses 1" OD copper tube—also available with two finned elements. This is the highest capacity convector for its cross section on the market. Easy to install.

WRITE FOR LITERATURE AND PRICES

STEAM BLEED HEATERS



For Residential, Commercial or Industrial Applications

This is the popular Rempe Hi-Cap line of heating coils. Equipped with the exclusive "Defrost-Tap" to keep coil warm during steam off-cycle and prevent freeze-up.
Single or double row designs available . . . any face area desired.
Eight, collared, Aluminum fins per inch on copper tube. Heavy steel casings.

Engineering Data Book

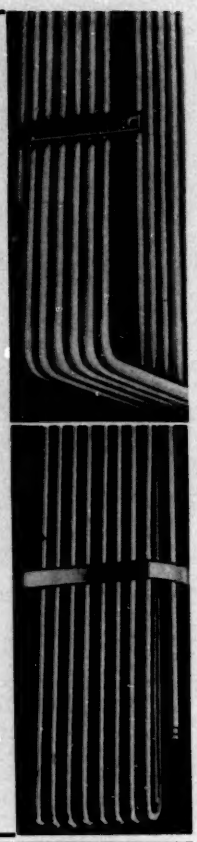
Pipe Coil and Fin Coil Designs. Heat Transfer Coefficients. Get a copy for your library.

REMPE COMPANY

PIPE BENDS

COILS, HEADERS AND FABRICATIONS...

the tougher the job, the better our expert metal-workers like it. With their modern equipment, they produce the finest work to your precise specifications. In any metal, even stainless steel, or up to 6-inch extra heavy. For fast, quality bends, backed by nearly 40 years specialization, call on us! May we quote on your next job?



CHICAGO NIPPLE & MFG. CO.
1997 Clybourn
Chicago 14

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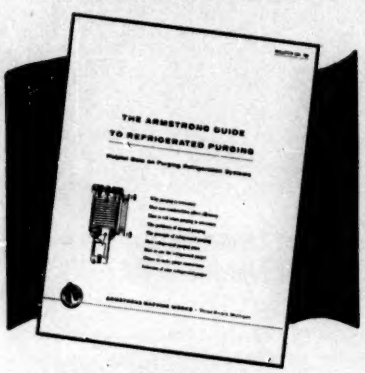

THE ARMSTRONG GUIDE TO REFRIGERATED PURGING

Here, in a new 12-page bulletin, are answers to the most commonly asked questions about removal of air from refrigerating system, from why you should to how to do it. Ask for your copy, today.

ARMSTRONG PURGERS

ARMSTRONG MACHINE WORKS
8606 Maple Street
Three Rivers, Michigan
The manufacturers of Armstrong Steam Traps

tains the minimum, but essential buying information, catalog number, size and price. The new angle is a small illustration or outline drawing which is provided to readily identify each type of flow control device or accessory. When Catalog or part numbers are not totally familiar, this illustrated alphabetical-numerical system results in fast, profitable communication between the Henry Wholesaler and his customers.

This improved Henry approach also takes cognizance of the fact that Wholesalers cannot always afford to catalog all items made by their manufacturing suppliers. Contractors, however, frequently require products not carried in the Wholesaler's Catalog. Due to insufficient space and numerous lines handled, less frequently used items may be difficult to identify or locate in a catalog. Thus, this relatively low cost condensed catalog type price schedule permits wider distribution and use by Wholesalers to supplement their own literature.

Insulating Fill Described In Brochure

»» PERLOX, a low-cost, low-density insulating fill for use with low temperature liquified gases, is described in a 4-page brochure published by Johns-Manville.

IN-307A describes the safety and effectiveness of Perlox, and lists its conductivity and physical properties. In addition, the 2-color brochure contains a chart demonstrating graphically the insulation effect per dollar obtained through use of materials for cryogenic applications.

Copies of IN-307A are available from Johns-Manville, 22 East 40th Street, New York 16, New York.

Detroit Controls Valve Catalog

»» ALL information required to order D. T. Williams valves is condensed in a 20-page catalog newly published in color by the manufacturer, Detroit Controls Division of American Standard.

The catalog, No. 800-A, also contains competitive cross reference charts and weight tables for comparative purposes, and data covering a variety of pressure controls, temperature controls, solenoid valves and strainers produced by Detroit Controls Division.

Instructions for saving shipping time by ordering D. T. Williams valves from the closest of three warehousess, located at Stratford, Conn., Chicago and Los Angeles, are included.

Copies of the D. T. Williams Catalog 800-A are available from Detroit Controls Division, 5900 Trumbull Avenue, Detroit 8, Mich.

Creamery Package Announces New Managers

»» ACCORDING to a recent announcement from M. P. Monson, regional manager of the Western Division of The Creamery Package Mfg. Company, Richard L. Brockmeyer has been promoted to manager of the firm's Los Angeles Branch; and John K. Hayes has been advanced to manager of CP's San Francisco Branch.

J. K. Hayes

R. L. Brockmeyer

Carey K. Tally, formery Los Angeles manager, has been appointed special representative for the Southern California area. In his new position, Mr. Tally will provide counsel on branch operation and sales, but will principally devote his time to the promotion of new product lines as well as new markets.

Mr. Brockmeyer joined Creamery Package in 1956 as a sales representative for the Los Angeles Branch and was promoted to assistant manager in 1959. He received his B.S. degree from Iowa State University and his Master's from the University of California. He spent two years in the Veterinary Corps of the Army; and worked for a leading dairy before joining CP.

John K. Hayes, new CP San Francisco branch manager, graduated from the University of Wisconsin where he was awarded a B.S. degree from the College of Agriculture as a Dairy Industry

major. He served in the U. S. Army Air Force from 1942 to 1946 with active duty in Europe, and is now a Captain in the Air Force Reserve. After six years of dairy production and sales experience in Japan and Honolulu, Mr. Hayes joined Creamery Package as a sales representative in both dairy and food fields.

Niagara Blower Representative Changes

»» PAUL H. Schoeflin, chief executive officer of the Niagara Blower Company, has announced that H. C. Roden, a district engineer at New York City, has transferred to Buffalo, N. Y. to be district engineer in that office. The move was effective October 1st.

R. M. Magner who has been district manager in Buffalo since 1946 and has represented the Niagara Blower Co. in Canada is moving to California where he will continue in selling and engineering for Niagara air conditioning, refrigeration and heat transfer equipment as an official of General Industrial Equipment Company, distributors of Niagara Blower Company apparatus, in Pacific Coast territories.

Allied Ammonia Agent For Louisiana

»» BARTLETT Chemicals of Orleans, Louisiana has been appointed agent by Allied Chemical Corporation, Nitrogen Division to handle Allied Chemical Anhydrous Ammonia in cylinders. Their distribution area will cover the entire state of Louisiana.

Bartlett Chemicals will maintain stocks at 1460 South Peters Street in New Orleans.

Director of Research

The appointment of Dr. John H. Pearson as director of advance research planning for Allied Chemical's General Chemical Division has been announced by John C. Fedoruk, technical director.

With the division 24 years, Dr. Pearson has served in a number of key technical capacities including those of assistant technical director, a post he held for eight years, and director of laboratory research.

Dr. Pearson is headquartered at the General Chemical Research Laboratory in Morristown, N. J. which is currently being expanded to double existing facilities, making room for almost 500 scientists and their supporting staffs.

An important part of the division's diversified research program is devoted to fluorine chemistry with emphasis on its atomic-energy and space-age roles. Dr. Pearson is well known in the field of fluorine chemistry and has supervised many of the Company's research projects in this line. Other areas of General's broad research program cover basic industrial and agricultural chemicals, and laboratory reagents.

Classified Advertising

All classified advertisements are payable in advance. Except for Positions and Help Wanted classifications, this section is reserved exclusively for USED equipment.

RATES: 20c per word; minimum 25 words. $2.00 per line for bold face headings: $15.00 per inch for line listings.

USED EQUIPMENT—wanted & for sale

REFRIGERATION EQUIPMENT FOR SALE
Advise Us Your Needs
Use QUICKSEAL—stops brine tank leaks.
Use CLERTEMPICE—clears and tempers ice.
Born Company 80 East Jackson Boulevard. Chicago 4, Illinois. WAbash 2-3299.

WANTED—used ammonia equipment. Write giving condition and price. Dade Service Corporation, 2160 N.W. 23rd St., Miami, Florida.

FOR SALE—Vilter 10½x10½ ammonia compressor, excellent condition, still hooked up; price $950. Write Box NV-10, c/o Industrial Refrigeration.

FOR SALE—3 York compressors, 7½x7½, 8x8, 9x9, all with AC motors and starters, recently reconditioned; located Michigan. Will sell one or all. Address Box NV-15, c/o Industrial Refrigeration.

FOR SALE—AMMONIA EQUIPMENT

2— 300 ton Niagara evaporative ammo. condensors.
1— 14x12" 4-cyl. Frick comp. D.C. to 600 h.p. motor, 327 r.p.m.
1— Worthington horiz. booster D.C. to 150 h.p. motor, 300 r.p.m.
2— 1 ton York ice making plants, 50# blocks, portable gasoline driven.
1— 10x10" 4-cyl. Frick duplex D.C. 225 h.p. motor.
3— 10x10" 4-cyl. York duplex D.C. 225 h.p. motor.
1— 9x9" 4-cyl. York duplex D.C. 150 h.p. motor.
3— 10x10" 2-cyl. York D.C. to 100 h.p. motor.
1— 9x9" 2-cyl. York D.C. to 75 h.p. motor.
2— 10x10" 2-cyl. York with V-type flywheel.
1— 9x9" 2-cyl. York with V-type flywheel.
2— 7-1/2"x7-1/2" & 8-1/2"x8-1/2" 2cyl. Vilter.
3x3", 4x4", 5x5" & 6x6" York & Frick comp.
3x3", 4x4" & 5x5" York Condensing units.
4— shell and tube condensers, 25 ton cap.
2— 300# Flynn & Emerick ice cubing machines.
2— 300# Gifford Wood ice cubing machines.

ENTERPRISE EQUIPMENT CORPORATION
328 Bryant Ave., Bronx 59, N. Y.
Cable "ENTREMA" Phone DAyton 8-2121

FOR SALE—at Leisey Brewery. 3 late model Vilter ammonia compressors, still erected with motors and all accessories; also considerable other refrigeration equipment including individual coolers, diffusers, ammonia pipe, etc. Write to Leisey Brewery, 3400 Vega Ave., Cleveland, Ohio.

FOR SALE

2—100 h.p. Carrier brine chilling units.
1—10x10 York direct connected 100 h.p.
2—5x5 Yorks w/evaporative condenser.
1—40 h.p. Frick Eclipse comp. w/diffusers.
3—Niagara #683 cold air diffusers.
2—60 h.p. G.E. motors, 860 rpm w/controls.

JOHN F. CARSON
A & Venago Sts. Philadelphia 34, Pa.
GArfield 6-2221

Miscellaneous

FOR SALE
PLAN AND SPECIFICATION

of our Automatic Oil Separator for ammonia refrigeration system. Increase the efficiency of your refrigeration up to 25 per cent; remove 99 per cent of the oil, not once, but continuously and automatically before it gets to the cooling coils; 24 hours per day. Saves trouble, labor and ammonia; tried, tested and approved for 5 years. Your engineer can build it for approximately $300.00. It is amazing; it is automatic. Plan and specification, $30.00.

FRANK W. PEARCE
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to stop RUST and RUST CREEPAGE*

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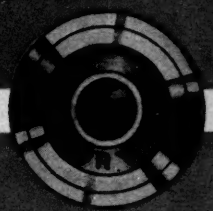

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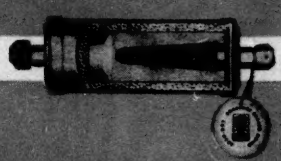

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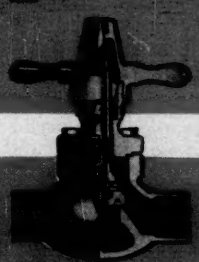

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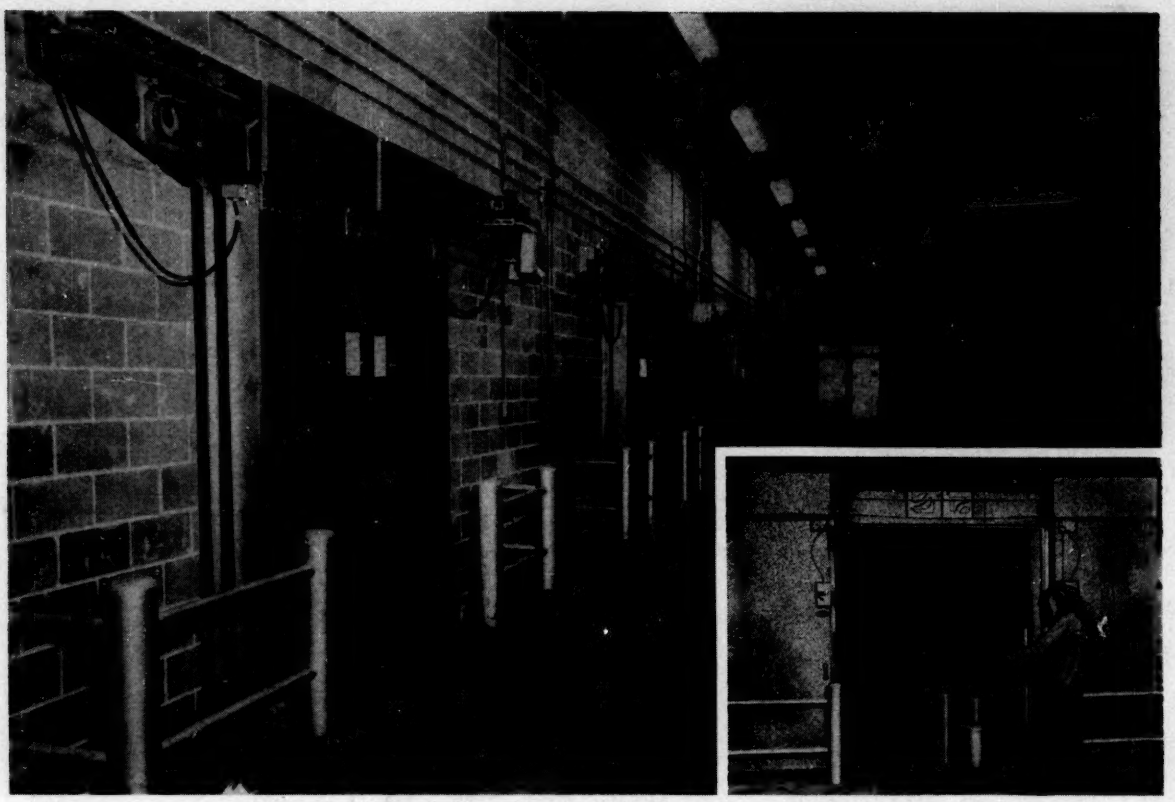

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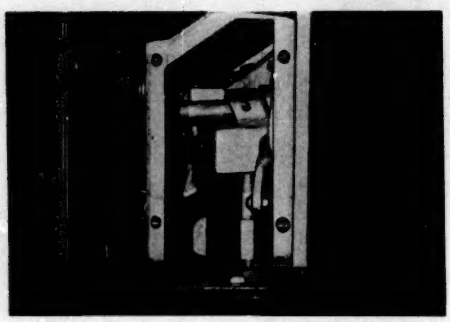

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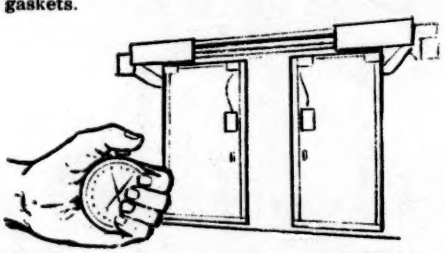

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